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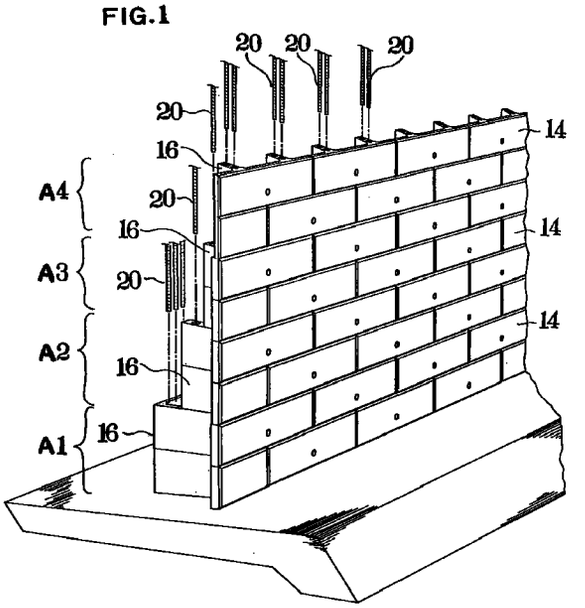
(54) Block for constructing a retaining wall and a constructed retaining wall structure

(57) A block (A) for constructing retaining wall comprises a front wall (14) and a counterfort (16) protruded from the back side of the front wall (14), wherein the counterfort (16) is provided with a plurality of reinforcing steel bar inserting holes (22) each of which has upper and lower ends thereof open-ended, and each reinforcing steel bar inserting hole (22) which is disposed in a front wall (14) side from the neutral plane (N-N) is either a tapered hole (26) increasing the diameter thereof from the upper opening to the lower opening thereof, and each reinforcing steel bar inserting hole (22) disposed in the rear end side from the neutral plane (N-N) is an inverse tapered hole having a diameter increasing from the lower opening to the upper opening. The above-mentioned blocks (A) for constructing retaining wall are stacked on the upper surface of a footing foundation (12) made of steel bar reinforced concrete, and a plurality of anchoring steel bars which protrude from the footing foundation (12) and a plurality of connecting steel bars are inserted into the steel bar inserting holes (22) which are vertically aligned with each other, and the filler is filled in the steel bar inserting holes (22) to construct the retaining wall. Due to such a construction, the hardened filler is prevented from sliding relative to the steel bar inserting hole (22) and the rigidity of the junctions where the abutting surfaces of the blocks for constructing retaining wall merge is increased to provide a rigid body integrally formed with the footing foundation (12).

FIG.1



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Description

BACKGROUND OF INVENTION

This invention relates to blocks for constructing retaining wall and a constructed retaining wall structure.

These days, as one of the retaining wall structures being constructed on the road or the seashore or the riverside, a retaining wall structure having a following constuction is known. Namely, a plurality of T-shaped blocks for constructing retaining wall are stacked in several layers on a footing foundation embedded in the soil until the retaining structure having a desired height is obtained.

Each T-shaped block for constructing retaining wall comprises a front wall and a counterfort or buttress which protrudes rearwardly from the back surface of the front wall. A plurality of holes for inserting reinforcing steel bar are formed in the counterfort. The counterforts of respective layers are overlapped with each other in a vertical direction so as to make their respective holes for inserting reinforcing steel bar aligned with each other and a plurality of anchoring steel bars which protrude from the footing foundation are inserted into the holes for inserting reinforcing steel bar. At the intermediate or upper portion of the constructed retaining wall structure, a plurality of connecting reinforcing steel bars which are connected with the anchoring reinforcing steel bars are inserted in the holes for inserting reinforcing steel bar. Simultaneously the filler such as cement mortar or concrete is filled in the holes for inserting reinforcing steel bar so as to integrally connect a plurality of blocks for constructing retaining wall in a vertically stacked manner to construct the retaining wall structure of a desired height.

However, since the soil pressure which acts on the retaining wall structure increases proportionally from the upper portion to the lower portion, the block for constructing the lowermost region of the retaining wall structure must be large in size and has a shape with an excellent section modulus. In the existing retaining wall structure, when the large-sized blocks are piled up or stacked, each block suffers from the poor section modulus because of the problems inherited with the holes for inserting reinforcing steel bar formed in each block. Accordingly, the maximum height of the retaining wall structure is approximately less than 10 m so that the retaining wall structure having a height greater than 10 m cannot be constructed.

Furthermore, the above-mentioned holes for inserting reinforcing steel bar are not formed in such a manner that they prevent the slide movement of the filler such as cement mortar relative to the steel bar, wherein such slide movement is caused by the contraction or shrinkage of the filler which takes place after being filled in the holes for inserting reinforcing steel bar. Accordingly, when an outer force acts on the blocks for constructing retaining wall which are stacked or piled up vertically, the cement mortar which is hardened or solidified in the holes for inserting reinforcing steel bar slide within the holes so that the retaining wall structure cannot have a sufficient rigidity.

Still furthermore, at the junctions or connecting portions where the blocks for constructing retaining wall which are stacked vertically are connected with each other, if the reinforcing steel bars which are inserted in the holes for inserting reinforcing steel bar are offset from the predetermined inserting position, the covering layer of the cement mortar or the concrete which is filled in the holes for inserting reinforcing steel bar becomes thin so that the adhering strength of the hardened filler to the blocks is deteriorated or weakened and accordingly the junctions or connecting portions where the blocks for constructing retaining wall which are stacked vertically are also deteriorated making the constructed retaining wall structure unstable.

Accordingly, it is an object of the present invention to solve above-mentioned conventional problems and to provide blocks for constructing retaining wall or constructed retaining wall structure, wherein the retaining wall has a height greater than the maximum height of the conventional retaining wall structure while satisfying the various constructionally theoretical conditions including the excellent section modulus, and can prevent the slide movement of the filler such as cement mortar or concrete hardened or solidified in the holes for inserting reinforcing steel bars thus assuring a sufficiently thick covering layer of filler even at the junctions or connecting portions where the blocks for constructing retaining wall which are stacked vertically are merged so that the blocks for constructing retaining wall which can be integrally connected with the foundation to provide the retaining wall structure constructed with such blocks.

SUMMARY OF INVENTION

For achieving the above object, the present invention provides a block for constructing retaining wall A, wherein the block A comprises a front wall 14 and a counterfort 16 protruded from the back side of the front wall 14, and the counterfort 16 is divided mainly by a plurality of partition walls 21 so as to form a plurality of reinforcing steel bar inserting holes therein 22 each of which has upper and lower ends thereof open-ended, and each reinforcing steel bar inserting hole 22 which is disposed in a front wall 14 side from a position assumed to be a neutral plane N-N of the block A is either a tapered hole 26 increasing the diameter from the upper opening to the lower opening thereof or a straight hole having a uniform diameter throughout the entire length thereof, and each reinforcing steel bar inserting hole 22 disposed in the rear end side from the neutral plane N-N is an inverse-tapered hole increasing a diameter from the lower opening to the upper opening.

Each reinforcing steel bar inserting hole 22 formed in the counterfort 16 may be provided with a trumpet-

shaped tapered face 28 at the upper and the lower ends thereof.

The invention also provides a constructed retaining wall structure 10, wherein the retaining wall structure 10 comprises a plurality of blocks A for constructing retaining wall, and each block A comprises a front wall 14 and a counterfort 16 protruded from the back side of the front wall 14, and the counterfort 16 is divided mainly by a plurality of partition walls 21 so as to form a plurality of reinforcing steel bar inserting holes 22 therein each of which has upper and lower ends thereof open-ended, and each reinforcing steel bar inserting hole 22 which is disposed in a front wall 14 side from a position assumed to be a neutral face N-N of a bending stress caused by an outer force acting on the block A in a direction toward the front wall 14 side from the rear sustaining wall 16 side is either a tapered hole 26 increasing the diameter from the upper opening to the lower opening thereof or a straight hole having a uniform diameter throughout the entire length thereof, and each reinforcing steel bar inserting hole 22 disposed in the rear end side from the neutral plane N-N is an inverse-tapered hole increasing a diameter from the lower opening to the upper opening, and the blocks A for constructing retaining wall are stacked on the upper surface of a steel bar reinforced concrete-made footing foundation 12 in such a manner that each reinforcing steel bar inserting hole 22 is vertically aligned with the reinforcing steel bar inserting hole 22 in the upper and lower layers, and a plurality of anchoring steel bars 18 protruded from the footing foundation 12 made of steel bar reinforced concrete and a plurality of connecting steel bars 20 which are used for connecting blocks A mounted on the footing foundation 12 are connected in the reinforcing steel bar inserting holes 22 and a filler M is filled in the reinforcing steel bar inserting holes 22 so as to integrally connect the blocks A for constructing retaining wall with each other.

The blocks A for constructing retaining wall includes a plurality kinds of blocks which are different in the length of counterfort 16, and the blocks A1 for constructing retaining wall having the greatest counterfort length are stacked on the upper surface of the steel bar reinforced concrete footing foundation 12 and the blocks A2, A3, A4 for constructing retaining wall having the shorter counterfort length are sequentially stacked so as to form the retaining wall structure which exhibit a stepped ladder shaped rear view.

The footing foundation 12 made of steel bar reinforced concrete comprises a front foot portion 32, a rear foot portion 34 which is connected to the rear end of the front foot portion 32 and has a slope face inclined downwardly from the front portion to the rear portion and a slippage preventing protrusion 36 formed on the bottom surface of the foundation 12, and the front portion 32 forms a stepped down foundation 38 at a toe portion, and the blocks A for constructing retaining wall are stacked on the slope face of rear portion in such a manner that the blocks for constructing retaining wall are stacked in an enbankment ingredient which is similar to a slope ingredient of a cut slope of a retaining wall construction site, and a back-filling concrete 40 is filled in the backside of the blocks A for constructing retaining wall stacked in the above manner from the upper portion of a heel plate of the rear foot portion 34.

With the blocks for constructing retaining wall and the constructed retaining wall structure according to this invention, a plurality of large-sized blocks for constructing retaining wall are stacked on the upper surface of the footing foundation made of steel bar reinforcing concrete, then the anchoring reinforcing steel bars and connecting reinforcing steel bars are inserted in respective aligned holes for inserting reinforcing steel bar, and the filler is filled in and hardened in the holes for inserting reinforcing steel bar so as to construct the lower portion of the retaining wall structure. On the upper surface of this lower portion of the retaining wall structure, a plurality of secondary large-sized blocks for constructing retaining wall are stacked in the same manner so as to construct the intermediate portion of the retaining wall. Furthermore, on the upper surface of this intermediate portion of the retaining wall structure, a plurality of intermediate-sized blocks for constructing retaining wall are stacked in the same manner so as to construct the upper portion of the retaining wall. Still furthermore, on the upper surface of this upper portion of the retaining wall structure, a plurality of small-sized blocks for constructing retaining wall are stacked in the same manner so as to construct the uppermost portion of the retaining wall.

In the constructed retaining wall structure, at the front-wall side of the retaining wall, the filler is filled and hardened in respective holes each of which has the diameter becoming greater downwardly in a tapered manner so as to form a plurality of elongated frustconically shaped struts which are, in turn, integrally connected with each other to form a steel bar reinforced pillar which is integrally connected with the footing foundation. Meanwhile, at the base portions of the counterforts of the blocks which abut with the back surface of the front walls, the filler is filled and hardened in respective holes each of which has the diameter becoming greater upwardly in a tapered manner so as to form a plurality of elongated inversely-frustconically shaped struts which are, in turn, integrally connected with each other to form a steel bar reinforced pillar which is integrally connected with the footing foundation.

Due to such a construction, even when a large soil pressure acts on the rear sustaining side of the retaining wall structure and eventually a compression force is exerted downwardly on the front wall side of the retaining wall while a tensile force is upwardly exerted on the rear end portion of the counterfort, the slide movement of the steel bar reinforced concrete pillar which is formed in the rear retaining wall can be prevented and the retaining wall structure can forms an integral rigid body which withstands the compression force and the tensile force thus enabling the construction of the retain-

ing wall having a height greater than the maximum height of the conventional retaining wall.

BRIEF EXPLANATION OF DRAWINGS

Fig. 1 is a perspective view of the retaining wall structure according to the embodiment of this invention.

Fig. 2 is a longitudinal cross sectional view of the retaining wall structure.

Fig. 3 is a plan view of the large-sized block for constructing retaining wall.

Fig. 4 is an elevational view of the large-sized block for constructing retaining wall.

Fig. 5 is a cross sectional view of the large-sized block for constructing retaining wall taken along the line B-B of Fig. 3.

Fig. 6 is a plan view of the secondary large-sized block for constructing retaining wall.

Fig. 7 is a cross sectional view of the secondary large-sized block for constructing retaining wall taken along the line C-C of Fig. 6.

Fig. 8 is a plan view of the middle-sized block for constructing retaining wall.

Fig. 9 is a cross sectional view of the middle-sized block for constructing retaining wall taken along the line D-D of Fig. 8.

Fig. 10 is a plan view of the small-sized block for constructing retaining wall.

Fig. 11 is a cross sectional view of the small-sized block for constructing retaining wall taken along the line E-E of Fig. 10.

Fig. 12 is a plan view of the small-sized block for constructing retaining wall of another embodiment.

Fig. 13 is a cross sectional view of the small-sized block for constructing retaining wall taken along the line F-F of Fig. 12.

Fig. 14 is an explanatory view showing the junctions of the steel bar inserting holes of the respective blocks for constructing retaining wall which are stacked vertically.

Fig. 15 is a side view showing the neutral plane against the bending stress of the solid steel bar reinforced T-shaped beam.

Fig. 16 is a stress diagram of the bending stress of the solid steel bar reinforced T-shaped beam shown in Fig. 15.

Fig. 17 is an enlarged longitudinal cross sectional view showing the steel bar inserting holes in the retaining wall constructed by blocks for constructing retaining wall.

Fig. 18 is a longitudinal cross sectional view of the retaining wall structure of another embodiment.

Fig. 19 is a longitudinal cross sectional view of the retaining wall structure of another embodiment.

PREFERRED EMBODIMENTS OF THIS INVENTION

The preferred embodiments of this invention is explained in conjunction with attached drawings.

In Fig. 1 and Fig. 2, a retaining wall 10 constructed by a plurality of blocks A for constructing a retaining wall according to the embodiment of this invention (constructed retaining wall structure) is shown.

As can be understood from the drawings, in the retaining wall 10, a plurality of large-sized blocks A1 for constructing retaining wall are stacked on a footing foundation 12 made of steel bar reinforced concrete in three layers so as to form a lower layer portion of the retaining wall 10. Each large-sized blocks A1 for constructing retaining wall is, as explained later, provided with a front wall 14 and a counterfort 16 which protrudes from the back surface of the front wall 14.

Furthermore, on the upper surface of the large-sized blocks A1 for constructing retaining wall, a plurality of secondary large-sized blocks A2, each of which has the counterfort 16 of a length shorter than that of the large-sized blocks A1 as explained later, are mounted in three layers so as to form an intermediate layer portion of the retaining wall 10.

Furthermore, on the upper surface of the secondary large-sized blocks A2 for constructing retaining wall, a plurality of middle-sized blocks A3, each of which has the counterfort 16 of a length shorter than that of the secondary large-sized blocks A2 as explained later, are mounted in three layers so as to form an upper layer portion of the retaining wall 10.

Still furthermore, on the upper surface of the upper layer portion, a plurality of small-sized blocks A4, each of which has the counterfort 16 of a length shorter than that of the middle-sized blocks A3 as explained later, are mounted in three layers so as to form an uppermost layer portion of the retaining wall 10.

The footing foundation 12 made of steel bar reinforced concrete and the large-sized blocks A1 for constructing retaining wall are integrally connected with each other by means of a plurality of anchoring steel bars 18 which protrude from the footing foundation 12 made of steel bar reinforced concrete. Meanwhile, the large-sized blocks A1 for constructing retaining wall, the secondary large-sized blocks A2 for constructing retaining wall, the middle-sized blocks A3 for constructing retaining wall and the small-sized blocks A4 for constructing retaining wall are integrally connected with each other. In this manner, with respect to the retaining wall 10 according to this embodiment, all blocks A for constructing retaining wall are integrally connected with the footing foundation 12 made by steel bar reinforced concrete with the connectng steel bars 20 whereby the retaining wall 10 becomes a rigid body having high strength and can resist the soil pressure acting on the back surface of the retaining wall 10.

The number of layers of stacked blocks A for constructing retaining wall is not limited to the embodiment and the blocks A for constructing retaining wall are stacked in a desired number of layers to construct the retaining wall 10 of a desired height.

The blocks A for constructing walls according to this invention include the concrete blocks molded without

arranging steel bars into the front wall 14 and the counterfort 16 as well as the steel bar reinforced concrete blocks molded while arranging main bars and distribution bars in the front wall 14 and the counterfort 16. Especially, when the constructed retaining wall structure 10 is constructed by blocks A for constructing retaining wall molded while arranging main bars and distribution bars in the blocks, the retaining wall 10 can have the excellent strength and section modulus.

In Fig. 3 to Fig. 11, the blocks A for constructing retaining wall according to the embodiment of this invention are shown.

As can be understood from these drawings, the block A for constructing retaining wall is made of steel bar reinforced concrete and comprises a front wall 14 formed in an elongated rectangular shape and a pair of counterforts 16,16 protruded from the back surface of the front wall 14 at positions adjacent to both lateral ends of the front wall 14.

Each counterfort 16 is divided by a plurality of partitions 21 into a plurality of reinforcing steel bar inserting holes 22 arranged in a rear sustaining wall protruding direction, wherein each reinforcing steel bar inserting hole 22 has the upper and lower ends thereof open-ended.

In the drawings, each counterfort 16 is provided with two or three holes 22 for inserting reinforcing steel bars and having a rectangular planar shape while the size of openings of these holes 22 becomes narrower as the length of the counterfort 16 of the respective blocks A for constructing rear wall becomes shorter. The planar shape of these holes 22 for inserting reinforcing steel bars may not necessarily limited to the above-mentioned shape and includes a circular shape, an elliptical shape, a polygonal shape. Although the holes 22 for inserting steel bar are formed by dividing the counterfort 16 by means of a plurality of partition walls 21, others may be used in lieu of these partition walls 21.

In these holes 22 for inserting reinforcing steel bar, the anchoring steel bars 18 and the connecting steel bars 20 which are connected with the anchoring steel bars 18 are inserted and then the filler such as cement mortar or concrete is filled in these holes 22.

As shown in the drawings, among all steel bar inserting holes 22, each reinforcing steel bar inserting hole 22 which is disposed in a front wall 14 side from a position assumed to be a neutral plane N-N of a bending stress caused by an outer force acting on the block in a direction toward the front wall 14 from the counterfort 16 is made of a tapered hole 24 increasing the diameter from the upper opening to the lower opeding thereof, while each reinforcing steel bar inserting hole disposed in the rear end side from the neutral plane is made of an inverse-tapered hole 26 having a diameter become greater from the lower opening to the upper opening.

The retaining wall having the above-mentioned constructed structure is a kind of T-shaped beam. In this case, however, since the stress on steel bars arranged at the position closest to the front wall 14 can be ignored, the retaining wall can be treated as a simple steel bar reinforced T-shaped beam.

Accordingly, when an outer force P such as soil pressure is exerted in a direction from the rear end side of the counterfort 16 to the front wall 14, the bending stress gives rise to as shown in Fig. 15 and the distance X from the compression brim (brim of the front face side) to the neutral plane N-N can be expressed by a following formula 1.

$$X = (ndAS + bt2/2) / (nAS + bt) \quad \text{(Formula 1)}$$

wherein, in the above formula

n = ratio between modulus of elasticity of concrete and steel (such as iron steel)
n = ES/EC
ES = modulus of elasticity of steel
EC = modulus of elasticity of concrete
AS = total cross sectional area of tensile steel bar (anchoring steel bar and connecting steel bar)
b = width of front wall
t = thickness of front wall
d = distance from the front surface of front wall to the center of tensile steel bar

The position of the neutral plane N-N calculated by the above-mentioned formula 1 is located approximately close to the front wall 14.

However, in case the counterfort 16 is considerably long and the total cross sectional area AS thereof is considerably large, such a neutral plane N-N calculated by the above-mentioned formula 1 is located close to the midst of the protruding length of the counterfort 16. When the protruding length of the counterfort 16 is short, the distance X from the compression brim (brim of the front face side) to the neutral plane N-N can be $X < t$ and is located in the front wall 14.

As shown in Fig. 15, when the simple steel bar reinforced T-shaped beam 27 receives a normal bending stress due to a pressing force P, a compression force is exerted on the front wall side portion of the simple steel bar reinforced T-shaped beam 27 from the neutral plane N-N which works as a center while a tensile force is exerted on the protruding end side of the simple steel bar reinforced T-shaped beam 27 as shown in the stress diagram of Fig. 16.

Accordingly, if the block A for constructing retaining wall is assumed to be the above-mentioned simple steel bar reinforced T-shaped beam 27, when a pressing force P is exerted on the block A for constructing retaining wall due to the soil pressure acting on the back surface side of the block A for constructing retaining wall, among a plurality of reinforcing steel bar inserting holes 22, tapered holes 24 which are disposed on the front wall 14 side and have the diameter becoming greater downwardly receive the compression strength while

tapered holes 26 which are disposed on the protruding end side of the counterfort 16 and have the diameter becoming greater upwardly receive the tensile strength.

As shown in Fig. 17, the blocks A for constructing retaining wall according to this invention are stacked on the upper surface of the footing foundation 12 made of steel bar reinforced concrete in several layers. In the reinforcing steel bar inserting holes 22 which are vertically aligned, the anchoring steel bars 18 which protrude upwardly from the footing foundation 12 made of steel bar reinforced concrete and the connecting steel bars 20 which are connected with the anchoring steel bars 18 are inserted. Subsequently, the filler M such as cement mortar or concrete is filled in the reinforcing steel bar inserting holes 22 and solidified to construct the retaining wall 10.

In the constructed retaining wall structure 10, at the front-wall 14 side of from the neutral plane N-N of the respective block A for constructing retaining wall, with the filler M which is filled and hardened in respective holes 22 each of which is made of a downwardly widened tapered hole 24, a steel bar reinforced pillar H1 made of a plurality of elongated frustconically shaped struts is integrally connected with the footing foundation 12.

Meanwhile, at the end portions of the counterforts 16 of the blocks from the neutral plane N-N, with the filler M which is filled and hardened in respective holes 22 each of which is made of upwardly widened tapered hole 26, a steel bar reinforced concrete pillar H2 made of a plurality of elongated inversely-frustconically shaped struts is integrally connected with the footing foundation 12.

Due to such a construction, in case a large soil pressure P acts on the counterfort 16 side of the retaining wall structure 10 in an arrow direction giving rise to a bending moment, a compression force is exerted downwardly on the front wall 14 side of the retaining wall 10, wherein the steel bar reinforced pillar H1 made of a plurality of elongated frustconically shaped struts resists the compression strength so that the friction resistance of the steel bar reinforced pillar H1 made of a plurality of elongated frustconically shaped struts relative to the steel bar inserting holes is increased preventing the relative slide movement between them, whereby the retaining wall can withstand the compression force and prevent the rupture thereof.

Furthermore, in the above condition where the soil pressure P acts on the retaining structure 10, although the tensile force is exerted upwardly on the protruding end of the counterfort 16, the steel bar reinforced concrete pillar H2 made of a plurality of elongated inversely-frustconically shaped struts resists the tensile strength so that the friction resistance of the the steel bar reinforced pillar H2 made of a plurality of elongated frustconically shaped struts relative to the steel bar inserting holes 26 is increased preventing the relative slide movement between them, whereby the retaining wall 10 can withstand the tensile force and can sufficiently meet the requirements necessary for a rigid body.

Furthermore, as shown in Fig. 3 to Fig. 11, each reinforcing steel bar inserting hole 22 formed in the counterfort 16 is provided with a trumpet-shaped tapered faces 28,28 at the upper and the lower ends thereof.

Due to such a construction, as shown in Fig. 17, on the abutting face of the vertically stacked blocks A for constructing retaining wall, the trumpet-shaped faces 28,28 formed on the lower end of the steel bar reinforcing holes 22 of one block A for constructing retaining wall are snugly merged with the trumpet-shaped faces 28,28 formed on the bottom end of the steel bar reinforcing holes 22 of the adjacent block A for constructing retaining wall, and the filler M is hardened in a space formed by merged upper and lower trumpet-shaped faces 28,28 to form a peripheral protrusion 30 having a diamond-shaped cross section.

Due to such a construction, the slide movement of the steel bar reinforced pillars H1,H2 formed in the aligned steel bar inserting holes 22 can prevent the slide movement relative to the blocks A for constructing retaining wall. Furthermore, the amount of the filler M which is filled in the steel bar connecting portions within the steel inserting holes 22 is increased so as to provide a desired amount of covering on the anchoring steel bar 18 and the connecting steel bars 22 so as to reinforce the strength of the constructed retaining wall structure.

The block A for constructing retaining wall which is explained above in view of drawings, is provided with a single downwardly widened tapered hole 24 at the front wall side thereof and in case the length of the counterfort 16 is long, the neutral plane N-N is shifted to the middle portion side of the counterfort 16. In this case, the rear portion of the downwardly widened tapered hole 24 is widened and the diameter of the neighboring tapered hole is narrowed.

The blocks A for constructing retaining wall are not limited to the large-sized blocks for constructing retaining wall which are described in the previously mentioned embodiment, but include the middle-sized or small-sized blocks for constructing retaining wall which are stacked on the large-sizd blocks so long as these blocks have the same remarkable function and effect.

Subsequently, the constructed retaining wall structure 10 according to this embodiment is explained hereinafter.

As shown in Fig. 1 and Fig. 2, for constructing the retaining wall 10, firstly, a plurality of large-sized blocks A1 for constructing retaining wall each of which comprises the front wall 14 and the counterfort 16 protruding from the back surface of the front wall 14 are stacked on the footing foundation 12 made of steel bar reinforced concrete in approximately three layers (number of layers being not limited) so as to form the lower layer portion of the retaining wall 10.

On the upper surface of the these stacked large-sized blocks A1 for constructing retaining wall, a plural-

ity of secondary large-sized blocks A2, a plurality of middle-sized blocks A3, a plurality of small-sized blocks A4 which have the counterfort 16 of a length sequentially shorter than that of the preceding blocks, are respectively mounted in a plurality of layers to construct the retaining wall 10.

In Fig. 3 to Fig. 5, the large-sized blocks A1 for constructing the lower layers of the constructed retaining wall structure 10 are shown.

Each large-sized blocks A1 comprises the laterally elongated front wall 14, a pair of counterforts 16,16 which protrude from the back surface of the front wall at positions adjacent to both lateral ends of the front wall 14, and each counterfort 16 is provided with three steel bar inserting holes 22 which are arranged in a counterfort protruding direction, have both upper and lower ends open-ended and have a rectangular planar shape.

As shown in Fig. 5, among these three steel bar inserting holes 22, the hole 22 which is disposed most close to the front wall 14 from the neutral plane N-N of the block A for constructing retaining wall is made of the downwardly widened tapered hole 24 increasing diameter from the upper end to the lower end, while two holes 22 which are disposed at the intermediate or end position located in the protruding end of the counterfort 16 from the above-mentioned neutral plane N-N are made of the upwardly widened tapered holes 26 increasing diameter from the bottom end to the upper end.

Furthermore, the trumpet-shaped enlarged tapered faces 28,28 are formed in the upper and lower ends of the above-mentioned steel bar inserting holes 22.

The above-mentioned large-sized blocks A1 for constructing retaining wall are stacked in a plurality of layers on the footing foundation 12 made of steel bar reinforced concrete, and the anchoring steel bars 18 which protrude upwardly from the footing foundation 12 are inserted in the vertically aligned reinforcing steel bar inserting holes 22, and the connecting steel bars 20 are connected to the anchoring steel bars 18, and the filler M such as the cement mortar or the concrete is filled and solidified in the aligned steel bar inserting holes 22.

In Fig. 6 and Fig. 7, the secondary large-sized blocks A2 which are stacked on the upper surface of the above-mentioned large-sized blocks A1 for constructing the intermediate layers of the constructed retaining wall structure 10 are shown.

This secondary large-sized block A2 comprises the laterally elongated front wall 14, a pair of counterforts 16,16 which protrude from the back surface of the front wall at positions adjacent to both lateral ends of the front wall 14. Each counterfort 16 has a length shorter than that of the counterfort 16 of the large-sized block A1 and is provided with two steel bar inserting holes 22 which have a planar rectangular shape and are arranged in a rear sustaining wall protruding direction.

As shown in Fig. 7, one steel bar inserting hole 22 which is disposed close to the front wall 14 from the neutral plane N-N of the block A for constructing retaining wall is made of the downwardly widened tapered hole 24 increasing diameter from the upper end to the lower end, while the other hole 22 is made of upwardly widened tapered hole 26.

Furthermore, the trumpet-shaped enlarged tapered faces 28,28 are formed in the upper and lower ends of the above-mentioned steel bar inserting holes 22.

As shown in Fig. 14, two steel bar inserting holes 22 (A2) formed in the above-mentioned secondary large-sized blocks A2 for constructing retaining wall are arranged so as to be aligned with steel bar inserting holes 22 (A1) formed in the front wall 14 side and the intermediate side of the counterfort 16.

The above-mentioned secondary large-sized blocks A2 for constructing retaining wall are stacked in the above-mentioned large-sized blocks A1, and within the steel inserting holes 22 of the secondary large-sized blocks A2 for constructing retaining wall, the connecting steel bars 20 protruding from the steel bar inserting holes 22 of the above-mentioned large-sized blocks A1 for constructing retaining wall are connected with succeeding connecting steel bars 20 and the filler M is filled and solidified.

Accordingly, the secondary large-sized blocks A2 for constructing retaining wall are firmly connected with the large-sized blocks A1 for constructing retaining wall. In the above condition, even when the soil pressure P acts on the back side of the counterfort 16, the compression force is exerted on the filler M and the connecting steel bars 20 in the steel inserting holes 22 at the front wall 14 side from the neutral plane N-N, while the tensile force is exerted on the filler M and the connecting steel bars 20 in the steel inserting holes 22 at the protruding side of the counterfort 16, the connecting steel bars 20 and the filler M in the steel bar inserting holes 22 exert a resistant force against the compression force at the front wall side from the neutral plane N-N and a resistant force against the tensile force at the protruding end side from the neutral plane N-N.

Furthermore, since the steel bar inserting holes 22 disposed at the front wall 14 side from the neutral plane N-N are made of downwardly widened tapered holes 24, while the steel bar inserting holes 22 disposed at the protruding end side of the counterfort 16 from the neutral plane N-N are made of upwardly widened tapered holes 26, even when the soil pressure acts on the retaining wall structure 10, the slide movement of the filler M hardened in the steel bar inserting holes 22 relative to the steel bar inserting holes 22 can be prevented thus enabling the construction of the retaining wall structure having high rigidity.

In Fig. 8 and Fig. 9, the middle-sized blocks A3 for constructing the upper layer of the constructed retaining wall structure 10 are shown.

This middle-sized block A3 comprises the front wall 14 having the same shape as the front wall 14 of the above-mentioned secondary large-sized block A2 for constructing retaining wall and a pair of counterforts 16,16 which protrude from the back surface of the front wall 14 at positions adjacent to both lateral ends of the

front wall 14. Each counterfort 16 is provided with two steel bar inserting holes 22,22.

As shown in Fig. 9, among steel bar inserting holes 22, one steel bar inserting hole 22 which is disposed close to the front wall 14 from the neutral plane N-N of the block A for constructing retaining wall is made of the downwardly widened tapered hole 24 increasing diameter from the upper end to the lower end, while the other hole 22 is made of upwardly widened tapered hole 26.

As shown in Fig. 14, two steel bar inserting holes 22 (A3) formed in the above-mentioned middle-sized blocks A3 for constructing retaining wall are arranged so as to be aligned with the steel bar inserting holes 22 (A2) formed in the front wall 14 side and the intermediate side of the counterfort 16. Furthermore, as shown in Fig. 9, the trumpet-shaped enlarged tapered faces 28,28 are formed in the upper and lower ends of the above-mentioned steel bar inserting holes 22.

In Fig. 10 and Fig. 11, the small-sized blocks A4 for constructing the uppermost layer of the constructed retaining wall structure 10 are shown.

This small-sized block A4 comprises the front wall 14 having the same shape as the front wall 14 of the above-mentioned middle-sized block A3 for constructing retaining wall and a pair of counterforts 16,16 which protrude from the back surface of the front wall 14 at positions adjacent to both lateral ends of the front wall 14 and have a length shorter than that of the middle-sized block A3 for constructing retaining wall.

Each counterfort 16 is provided with two steel bar inserting holes 22,22.

As shown in Fig. 14, these two steel bar inserting holes 22 (A4) formed in the counterfort 16 of the above-mentioned small-sized block A4 for constructing retaining wall are provided such that they are aligned with the steel bar inserting holes 22 (A3) formed in the counterfort 16 of the above-mentioned middle-sized block A3 which are disposed close to the front wall 14 side.

As shown in Fig. 11, among two steel bar inserting holes 22 of the above small-sized block A4 for constructing retaining wall, one steel bar inserting holes 22 which is disposed at the front wall 14 side from the neutral plane N-N is made of a downwardly widened taper-shaped hole 24 while the other steel bar inserting hole 22 is made of an upwardly widened taper-shaped hole 26.

Furthermore, each steel bar inserting hole 22 is provided with trumpet-shaped enlarged tapered faces 28,28 at the upper and lower ends thereof.

The above-mentioned middle-sized blocks A3 for constructing retaining wall are stacked on the upper surface of the above-mentioned secondary large-sized blocks A2 for constructing retaining wall so as to construct the upper layer of the retaining wall structure 10, while the small-sized blocks A4 for constructing retaining wall are stacked on the upper surface of these middle-sized blocks A3 for constructing retaining wall. The connecting steel bars 20 are inserted in the steel bar inserting holes 22 which are vertically aligned and the filler M is filled and hardened so as to form the uppermost layer portion of the retaining wall structure 10.

As has been explained above, in the above-mentioned retaining wall structure 10, the blocks A comprising the large-sized blocks A1 for constructing retaining wall, the secondary large-sized blocks A2 for constructing retaining wall, the middle-sized blocks A3 for constructing retaining wall and the small-sized blocks A4 for constructing retaining wall are stacked in layers on the footing foundation 12 made of steel bar reinforced concrete, and the anchoring steel bars 18 and the connecting steel bars 20 which are connected with anchoring steel bars 18 are inserted in the steel bar inserting holes 22 which are vertically aligned with each other, and the filler M such as cement mortar or the concrete is filed in the aligned steel bar inserting holes 22.

Accordingly, in the above-mentioned retaining wall structure 10, for example, as shown in Fig. 17, at the front wall 14 side from the neutral plane N-N of the block A for constructing retaining wall, the filler M is filled and hardened in respective holes 24 each of which has the diameter becoming greater downwardly in a tapered manner so as to form a plurality of elongated frustoconically shaped struts which are, in turn, integrally connected with each other to form the steel bar reinforced concrete pillar H1 and such a steel bar reinforced concrete pillar H1 is integrally connected with the footing foundation 12 made of steel bar reinforced concrete.

Furthermore, at the protruding end portions of the counterforts 16 of blocks A for constructing retaining wall from the neutral plane N-N, the filler M is filled and hardened in respective holes 26 each of which has the diameter becoming greater upwardly in a tapered manner so as to form a plurality of inversely-frustoconically shaped struts which are, in turn, integrally connected with each other to form the steel bar reinforced pillar H2 which is integrally connected with the footing foundation 12 made of steel bar reinforced concrete.

Due to such a construction, in case a large soil pressure acts on the rear sustaining side of the retaining wall structure 10, the bending stress is produced. Because of this bending stress, a compression force is exerted downwardly on the front wall 14 side of the counterfort 16. However, the steel bar reinforced concrete pillar H1 which is formed by a plurality of elongated frustoconically shaped struts made of hardened filler M in the downwardly widened tapered holes can withstand the compression force and prevent the slide movement thereof relative to the tapered holes.

Furthermore, on the protruding end of the counterfort 16, the upward tensile force is exerted. However, the steel bar reinforced concrete pillar H2 which is formed by a plurality of elongated inversely frustoconically shaped struts made of hardened filler M in the upwardly widened tapered holes 26 can withstand the compression force and prevent the slide movement thereof relative to the tapered holes.The steel bar reinforced concrete pillar H2 can prevent the slide movement thereof relative to the steel bar inserting holes made of

inversely tapered holes 26 and withstand the tensile strength.

Accordingly, the retaining wall structure 10 can be a retaining wall structure having a sufficient condition as a rigid body.

In each block A for constructing retaining wall, the steel bar inserting holes 22 at the front wall 14 side of the counterfort 16 from the neutral plane N-N of the bending stress and can be made of a straight hole instead of the downwardly widened tapered hole 24.

In this case, in the steel bar inserting holes 22 which are vertically aligned with each other, a straight shaped pillar made of steel bar reinforced concrete is formed and such a pillar can withstand the tensile force acting on the front wall 14 side.

Furthermore, on the abutting face of the vertically stacked blocks A for constructing retaining wall, the trumpet-shaped faces 28,28 formed on the lower end of the steel bar reinforcing holes 22 of one block A for constructing retaining wall are snugly merged with the trumpet-shaped faces 28,28 formed on the upper end of the steel bar reinforcing holes 22 of the adjacent block A for constructing retaining wall, and the filler M is hardened in a space formed by merged upper and lower trumpet-shaped faces 28,28 to form a peripheral protrusion 30 having a diamond-shaped cross section.

Due to such a construction, the slide movement of the steel bar reinforced pillars H1,H2 formed in the aligned steel bar inserting holes 22 can prevent the slide movement relative to the blocks A for constructing retaining wall.

Furthermore, the amount of the filler M which is filled in the steel bar connecting portions within the steel inserting holes 22 is increased so as to provide a desired amount of covering on the anchoring steel bar 18 and the connecting steel bars 22 thus reinforcing the strength of the constructed retaining wall structure.

In the above-mentioned retaining wall structure 10, the large-sized blocks A1 for constructing retaining wall which has the longest counterfort 16 are mounted on the footing foundation 12 made of steel bar reinforced concrete, and the secondary large-sized blocks A2 for constructing retaining wall, the middle-sized blocks A3 for constructing retaining wall and the small-sized blocks A4 for constructing retaining wall which sequentially shorten the length of the counterfort 16 are stacked, wherein the counterforts 16 are stacked in a step-like manner.

Due to such a construction, in the counterforts 16 which are stacked in a step like manner, the filler is filled and solidified in a plurality of steel bar inserting holes 22 which are vertically aligned and having an upwardly widened tapered inversely frustoconical hole to form a steel bar reinforced concrete pillar H2 which is integrally connected with the footing foundation 12 made of steel bar reinforced concrete, whereby the rigid body which has a sufficient resistance against the soil pressure which increases in a secondary curve from the intermediate layer to the lower layer of the retaining wall structure so that the retaining wall structure having a height exceeding the maximum height of the conventional retaining wall structure can be constructed.

In Fig. 18, the constructed retaining structure 10 of another embodiment is shown.

In this constructed retaining structure 10, the lower layer is formed on the the footing foundation 12 made of steel bar reinforced concrete by stacking up the secondary large-sized blocks A2 for constructing retaining wall, and the intermediate layer is formed by stacking up the middle-sized blocks A3 for constructing retaining wall and the small-sized blocks A4 for constructing retaining wall, and uppermost layer portion is formed by stacking up the small-sized blocks A5 for constructing retaining wall.

The above-mentioned small-sized block A5 for constructing retaining wall is, as shown in Fig. 12 and Fig. 13, provided with a front wall 14 and a pair of counterforts 16,16 protruded from the back surface of the front wall 14.

These counterfort 16 of the small-sized blocks A5 for constructing retaining wall is provided with a single reinforce steel bar inserting hole 22 which communicates with the reinforced steel bar inserting hole 22 provided at the front wall 14 side of the counterfort 16 and is made of a straight hole having a uniform diameter throughout the length thereof instead of the upwardly widened tapered hole 26.

Furthermore, the steel bar inserting hole 22 is provided with trumpet-shaped widened tapered faces 28 at the upper and lower ends thereof.

Although the constructed retaining wall structure 10 is employed for constructing the low retaining wall structure, as in the case of the previous embodiment, the anchoring steel bars 18 and the connecting steel bars 20 are inserted in the steel bar inserting holes 22 which are vertically aligned and the filler is filled in the steel bar inserting holes 22 so as to construct the retaining wall structure having the section modulus.

In Fig. 19, the constructed retaining structure 10 of another embodiment is shown.

The footing foundation 12 made of steel bar reinforced concrete of this retaining wall structure 10 is provided with a front foot portion 32, a rear foot portion 34 which is connected to the rear end of the front portion 32 and is provided with an inclined face inclined downwardly from the front end to the rear end thereof, and a slippage preventing protrusion 36 protruded downwardly from the bottom of the foundation 12, wherein the footing foundation 12 is also provided with a stepped down foundation 38 at the toe portion thereof.

With respect to the footing foundation 12 made of steel bar reinforced concrete, on the inclined surface of the rear foot portion 34, for example, from the lower layer, the above-mentioned large-sized block A1 for constructing retaining wall, the intermediate blocks A3 for constructing retaining wall and the small-sized blocks A5 are stacked on the slope ingredient K of the

cut slope of the construction site, with each blocks in a plurality of layers.

Then, as in the case of the previous embodiment, a plurality of anchoring steel bars protruded from the inclined surface of the rear foot portion 34 and a plurality of connecting steel bars which are connected with the anchoring steel bars are inserted into a plurality of steel bar inserting holes 22 vertically aligned with each other and then the filler is filled in the aligned steel bar inserting holes 22.

Simultaneously, in a space defined by the upper surface of the heel plate of the rear foot portion 34 and the back surface of the above-mentioned large-sized blocks A1 for constructing retaining wall, a back-fill concrete 40 is filled and, subsequently, in a space defined back of the above-mentioned middle-sized blocks A3 for constructing retaining wall A3 and the small-sized blocks A5 for constructing retaining wall, the back-fill materials 42 such as cobble stones, gravels and crusher runs are filled so as to construct the retaining wall 10. In the drawings, numeral 44 indicates a slope enbankment.

Due to such a construction, in the constructed retaining structure 10 according to this embodiment, all the blocks A which are vertically stacked with each other are integrally connected with the footing foundation 12 made of steel bar reinforced concrete and the leaning force of the respective stacked block A for constructing retaining wall acts on the slope surface of the cut slope and resists the earth pressure and because of this leaning force, the retaining wall having a height far higher than the height of the retaining wall which is vertically constructed.

In this embodiment, the width of the front and rear portions of the front foot portion 32 is made greater than the width of the front and rear portions of the rear foot portions 34. Due to such a construction, the footing foundation 12 made of steel bar reinforced concrete can increase the rigidity in a transverse direction so that the footing foundation 12 can remarkably increase the resisting force, namely, the resisting moment against the turn down moment.

Furthermore, the above-mentioned footing foundation 12 made of steel bar reinforced concrete is provided with a protruding protrusion 36 on the bottom surface thereof and a stepped down foundation 38 at the toe portion thereof. Accordingly, even at the site where the earth pressure is large, the slide movement of the footing foundation 12 made of steel bar reinforced concrete can be prevented. Especially, the slide movement preventing effect of the stepped down foundation 38 is remarkable.

At the construction site where the height of the retaining wall 10 is low and the earth pressure is small, it is unnecessary to provide the slide movement preventing protrusion 36 on the bottom surface of the footing foundation 12, while it is also unnecessary to provide the backfill concrete 40 in a space back of the large-sized blocks for constructing retaining wall. Instead, the backfill material such as the cobble stones, the gravels and the crusher runs are filled in the backfill material in the space so as to save the construction cost.

[Effect of Invention]

As has been described heretofore, due to the blocks for constructing retaining wall structure according to claim 1, the block comprises a front wall and a counterfort protruded from the back side of the front wall, and the counterfort is divided mainly by a plurality of partition walls so as to form a plurality of reinforcing steel bar inserting holes each of which has upper and lower ends thereof open-ended, and each reinforcing steel bar inserting hole which is disposed in a front wall side from a position assumed to be a neutral face of a bending stress caused by an outer force acting on the block in a direction toward the front wall side from the counterfort side is either a tapered hole increasing the diameter from the upper opening to the lower opening thereof or a straight hole having a uniform diameter throughout the entire length thereof, and each reinforcing steel bar inserting hole disposed in the rear end side from the neutral face is an inverse-tapered hole having a diameter become greater from the lower opening to the upper opening. The above-mentioned blocks for constructing retaining wall are stacked on the upper surface of the footing foundation made of steel bar reinforced concrete, and the anchoring steel bars which protrude from the footing foundation and the connecting steel bars are inserted into the steel bar inserting holes which are vertically aligned with each other, and the filler is filled in the steel bar inserting holes to construct the retaining wall. Due to such a construction, the hardened filler is prevented from sliding relative to the steel bar inserting hole and the rigidity of the junction where the abutting surfaces of the blocks for constructing retaining wall merge is increased to provide the rigid body integrally formed with the foundation and the retaining wall meets the various constructional requirements including excellent section modulus so that the retaining wall has a height greater than the maximum height of the conventional retaining wall structure.

According to claim 2, each reinforcing steel bar inserting hole formed in the counterfort may be provided with a trumpet-shaped tapered face at the upper and the lower ends thereof. Accordingly, when these blocks for constructing retaining wall are stacked so as to construct the retaining wall, the amount of filler filled in the junctions where steel bar inserting holes are merged can be increased so that the anchoring steel bars and the connecting bars can be covered with a proper amount of covering of filler thus reinforcing the strength of the constructed retaining wall structure while increasing the rigidity of the junctions where blocks are merged with each other.

Subsequently in the constructed retaining wall structure according to claim 3, the retaining wall struc-

ture comprises a plurality of blocks for constructing retaining wall, and each block comprises a front wall and a counterfort protruded from the back side of the front wall, and the counterfort is divided mainly by a plurality of partition walls so as to form a plurality of reinforcing steel bar inserting holes each of which has upper and lower ends thereof open-ended, and each reinforcing steel bar inserting hole which is disposed in a front wall side from a position assumed to be a neutral face of a bending stress caused by an outer force acting on the block in a direction toward the front wall side from the counterfort side is either a tapered hole increasing the diameter from the upper opening to the lower opening thereof or a straight hole having a uniform diameter throughout the entire length thereof, and each reinforcing steel bar inserting hole disposed in the rear end side from the neutral plane is an inverse-tapered hole having a diameter become greater from the lower opening to the upper opening, and the blocks for constructing retaining wall are stacked on the upper surface of a steel bar reinforced concrete-made footing foundation in such a manner that each reinforcing steel bar inserting hole is vertically aligned with the reinforcing steel bar inserting hole in the upper and lower layers, and a plurality of anchoring steel bars protruded from the footing foundation made of steel bar reinforced concrete and a plurality of connecting steel bars which are used for connecting blocks mounted on the footing foundation are connected in the reinforcing steel bar inserting holes and a filler is filled in the reinforcing steel bar inserting holes so as to integrally connect the blocks for constructing retaining wall with each other.

In the steel bar inserting holes at the front wall side from the neutral plane, the filler is filled in the aligned downwardly widened tapered holes to form the steel bar reinforced concrete pillar which is merged with the footing foundation, while in the steel bar inserting holes at the counterfort side from the neutral plane, the filler is filled in the aligned upwardly widened tapered holes to form the steel bar reinforced concrete pillar which is merged with the footing foundation. Therefore, even when the earth pressure acts on the retaining wall structure from the counterfort side and the bending stress is exerted and due to this bending stress, the downward compression force acts on the front wall side and the upward tensile force acts on the protruding end of the counterfort, the slide movement of the steel bar reinforced concrete pillar relative to the block can be prevented and the retaining structure can withstand the compression force and the tensile force and can meet the requirements necessary for the rigid body and due to the elastic design method according to the elastic theory, the retaining structure having strong rigidity can be economically constructed.

Furthermore, according to claim 4, the blocks for constructing retaining wall includes a plurality kinds of blocks which are different in the length of counterfort, and the blocks for constructing retaining wall having the greatest counterfort length are stacked on the upper surface of the steel bar reinforced concrete footing foundation and the blocks for constructing retaining wall having the shorter counterfort length are sequentially stacked so as to form the retaining wall structure which exhibit a stepped ladder shaped rear view. In the above-mentioned terrace-shaped retaining wall structure, the filler is filled in the upwardly widened steel bar reinforcing holes which are aligned with each other to build up the steel bar reinforced concrete pillar made of a plurality of steel bar reinforced inversely tapered concrete struts on the footing foundation and the retaining wall structure having a sufficient rigidity against the earth pressure which gradually increases from the upper layer to the lower layer thus enabling the construction of the retaining wall structure having a height exceeding several tens of meters.

Still furthermore, according to claim 5, the footing foundation made of steel bar reinforced concrete comprises a front foot portion, a rear foot portion which is connected to the rear end of the front portion and has a slope face inclined downwardly from the front portion to the rear portion and a slippage preventing protrusion formed on the bottom surface of the foundation, and the front portion forms a stepped down foundation at a toe portion, and the blocks for constructing retaining wall are stacked on the slope face of rear foot portion in such a manner that the blocks for constructing retaining wall are stacked with an enbankment ingredient approximately similar to the slope ingredient of the cut slope of the retaining wall construction site. Furthermore, on the heel portion of the rear foot portion, the backfill concrete is filled in the back side of the blocks for constructing retaining wall so that the retaining wall which is integrally connected with the footing foundation made of steel bar reinforced concrete is constructed and such retaining wall has an excellent section modulus to provide the retaining wall structure having a height higher than the conventional retaining wall structure.

Claims

1. Block for constructing retaining wall, wherein

the block comprises a front wall and a counterfort protruded from the back side of the front wall, and
the counterfort is divided substantially by a plurality of partition walls so as to form a plurality of reinforcing steel bar inserting holes therein each of which has upper and lower ends thereof open-ended, and
each reinforcing steel bar inserting hole which is disposed in a front wall side from a position assumed to be a neutral plane of a bending stress caused by an outer force acting on the block in a direction toward the front wall from the counterfort is either a tapered hole increasing a diameter thereof from the upper opening to the lower opening thereof or a straight hole

having a uniform diameter throughout the entire length thereof, and

each reinforcing steel bar inserting hole disposed in the rear end side from the neutral plane is an inverse-tapered hole increasing a diameter thereof from the lower opening to the upper opening.

2. A block for constructing retaining wall according to claim 1, wherein each reinforcing steel bar inserting hole is provided with a trumpet-shaped tapered face at the upper and the lower ends thereof.

3. A constructed retaining wall structure, wherein

the retaining wall structure comprises a plurality of blocks for constructing retaining wall, wherein

each block for constructing retaining wall comprises a front wall and a counterfort protruded from the back side of the front wall, and

the counterfort is divided mainly by a plurality of partition walls so as to form a plurality of reinforcing steel bar inserting holes each of which has upper and lower ends thereof open-ended, and each reinforcing steel bar inserting hole which is disposed in a front wall side from a position assumed to be a neutral plane of a bending stress caused by an outer force acting on the block in a direction toward the front wall from the counterfort is either a tapered hole increasing a diameter thereof from the upper opening to the lower opening thereof or a straight hole having a uniform diameter throughout the entire length thereof, and

each reinforcing steel bar inserting hole disposed in the rear end side from the neutral plane is an inverse-tapered hole increasing a diameter thereof from the lower opening to the upper opening, and

the blocks for constructing retaining wall are stacked on the upper surface of a steel bar reinforced concrete-made footing foundation in such a manner that each reinforcing steel bar inserting hole is vertically aligned with the reinforcing steel bar inserting hole in the upper and lower layers,

a plurality of anchoring steel bars protruded from the footing foundation made of steel bar reinforced concrete and a plurality of connecting steel bars which are used for connecting blocks mounted on the footing foundation are connected in the reinforcing steel bar inserting holes and a filler is filled in the reinforcing steel bar inserting holes so as to integrally connect the blocks for constructing retaining wall with each other.

4. A constructed retaining wall structure according to claim 3, wherein

the blocks for constructing retaining wall includes a plurality kinds of blocks which are different in the length of counterfort,

the blocks for constructing retaining wall having the greatest counterfort length are stacked on the upper surface of the steel bar reinforced concrete footing foundation and the blocks for constructing retaining wall having the shorter counterfort length are sequentially stacked so as to form the retaining wall structure which exhibits a stepped ladder shaped rear view.

5. A constructed retaining wall structure according to claim 3 or 4, wherein

the footing foundation made of steel bar reinforced concrete comprises a front foot portion, a rear foot portion which is connected to the rear end of the front portion and has a slope face inclined downwardly from the front portion to the rear portion and a slippage preventing protrusion formed on the bottom surface of the foundation, and

the front portion forms a stepped down foundation at a toe portion,

the blocks for constructing retaining wall are stacked on the slope face of rear portion in such a manner that the blocks for constructing retaining wall are stacked with an enbankment ingredient which is similar to a slope ingredient of a cut slope at a retaining wall construction site, and

back-filling concrete is filled in the backside of the blocks for constructing a retaining wall stacked in the above manner from the upper portion of a heel plate of the rear foot portion.

FIG.1

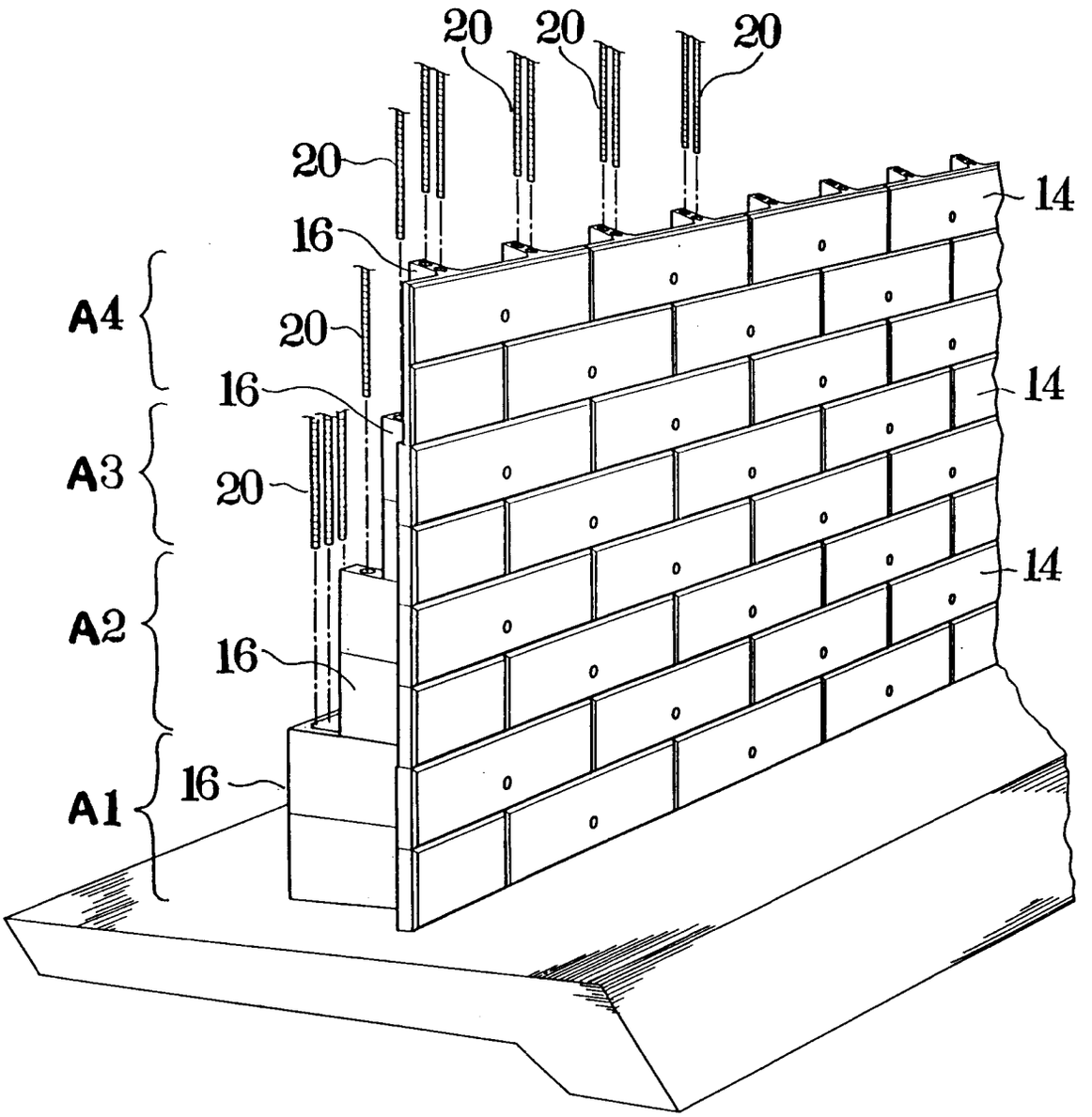


FIG. 2

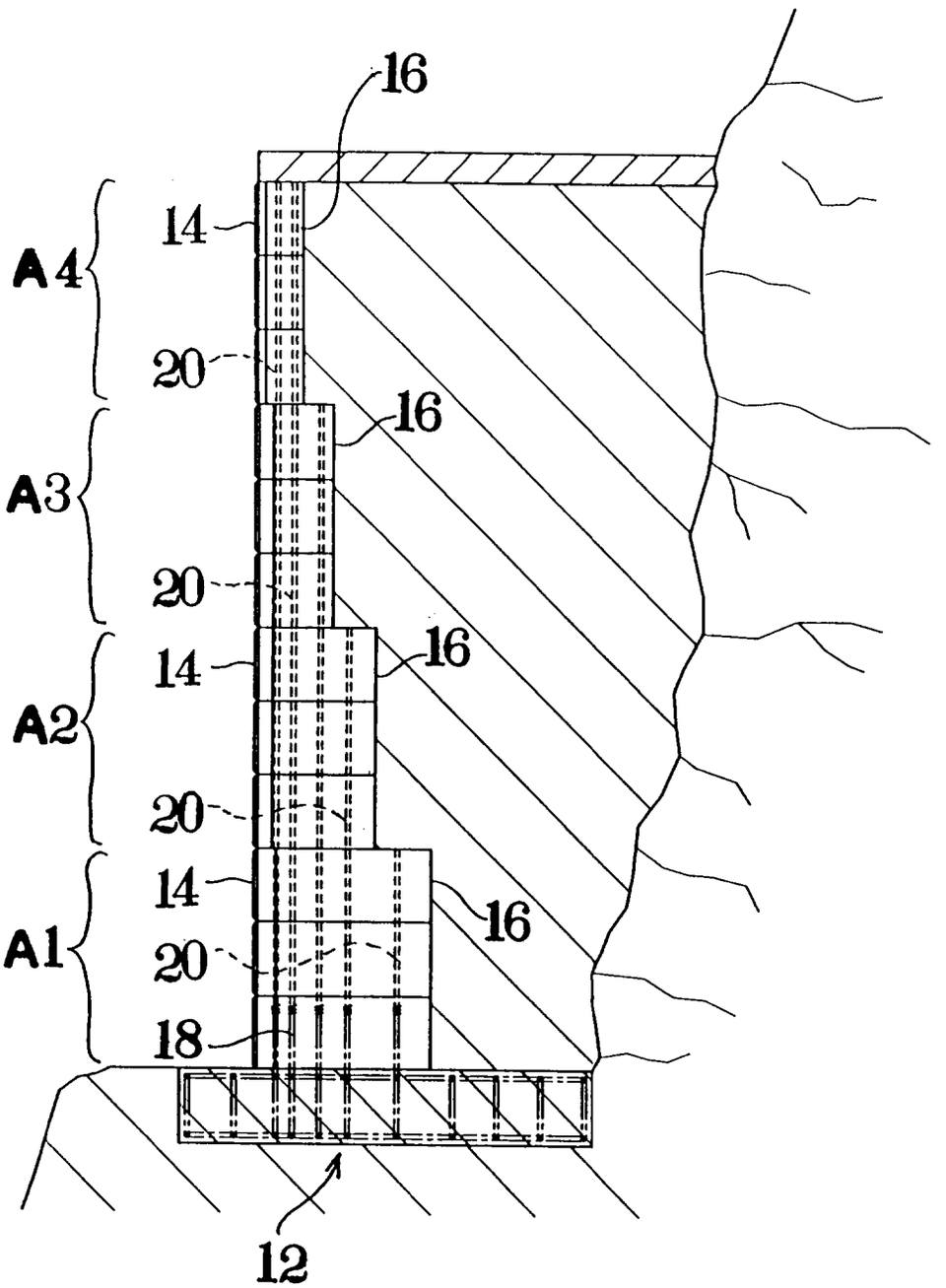


FIG.3

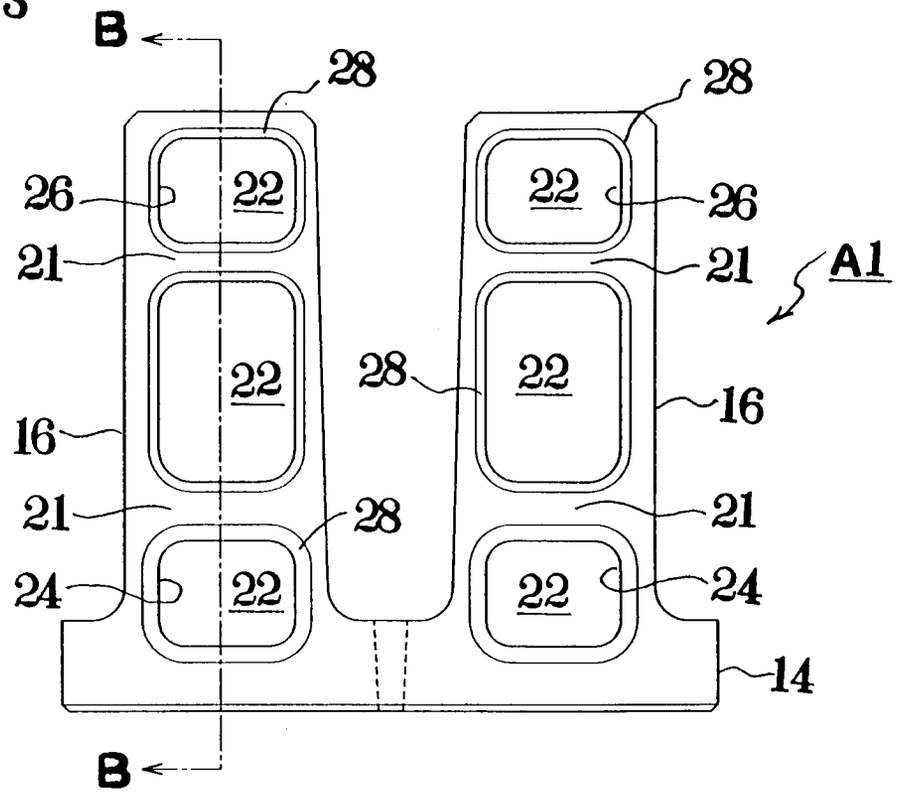


FIG.4

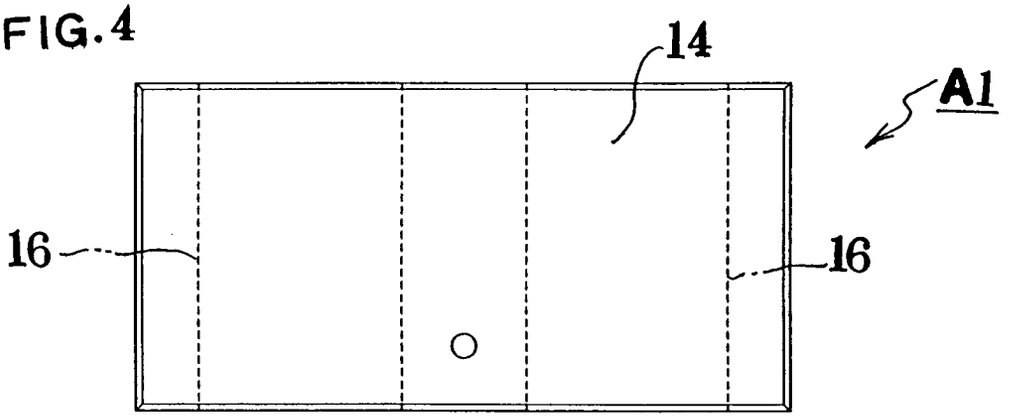


FIG.5

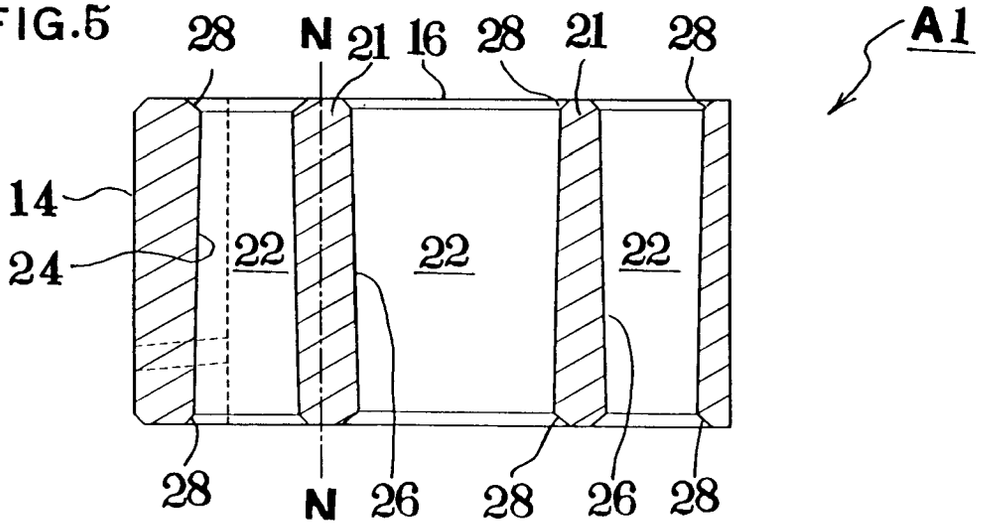


FIG.6

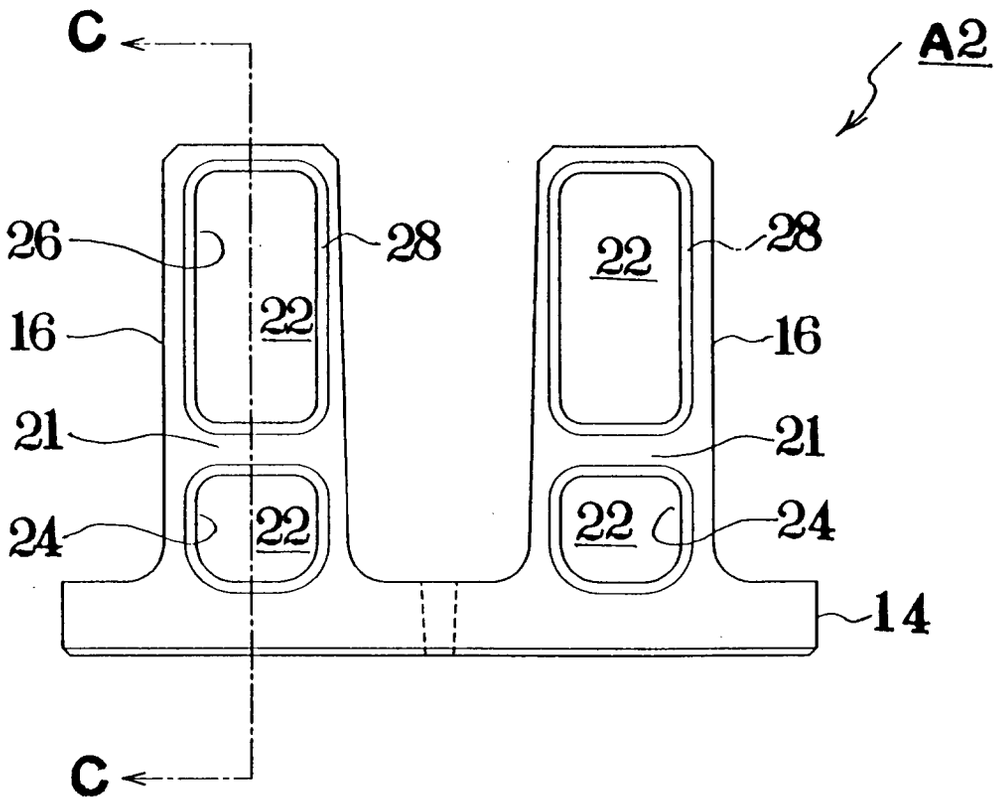

C
A2
26
28
22
28
16
22
16
21
21
24
22
22
24
14
C

FIG.7

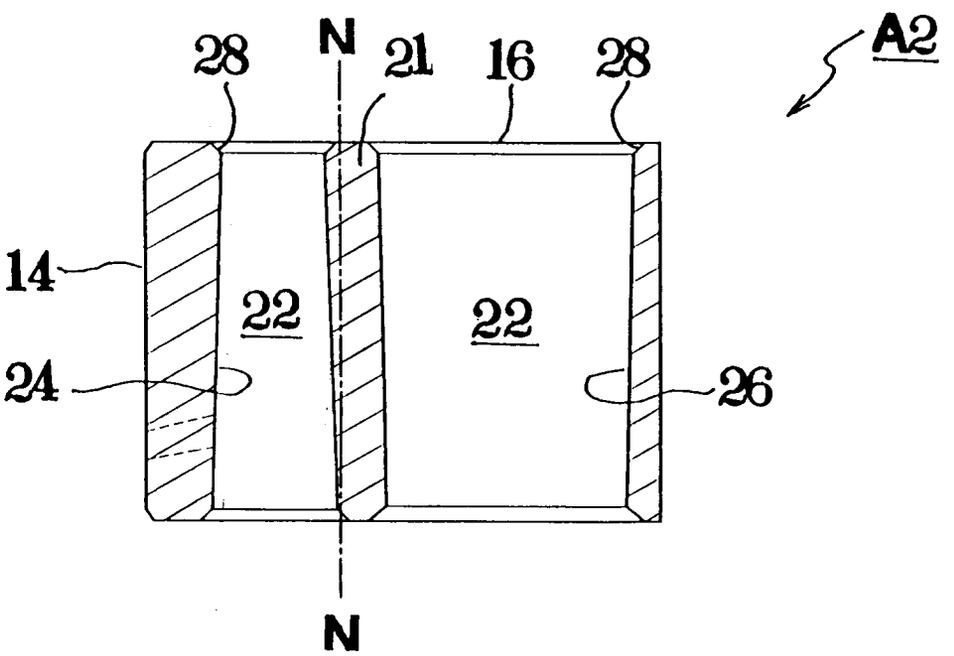

28
N
21
16
28
A2
14
22
22
24
26
N

FIG.8

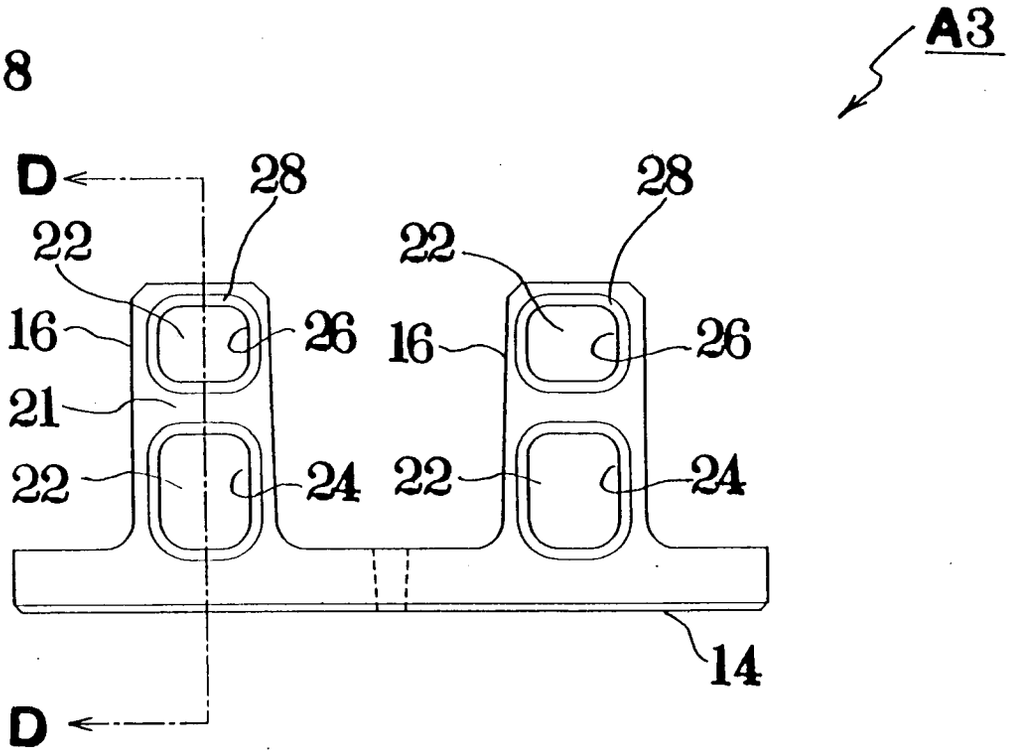

A3
D
28
28
22
22
16
26
16
26
21
22
24
22
24
14
D

FIG.9

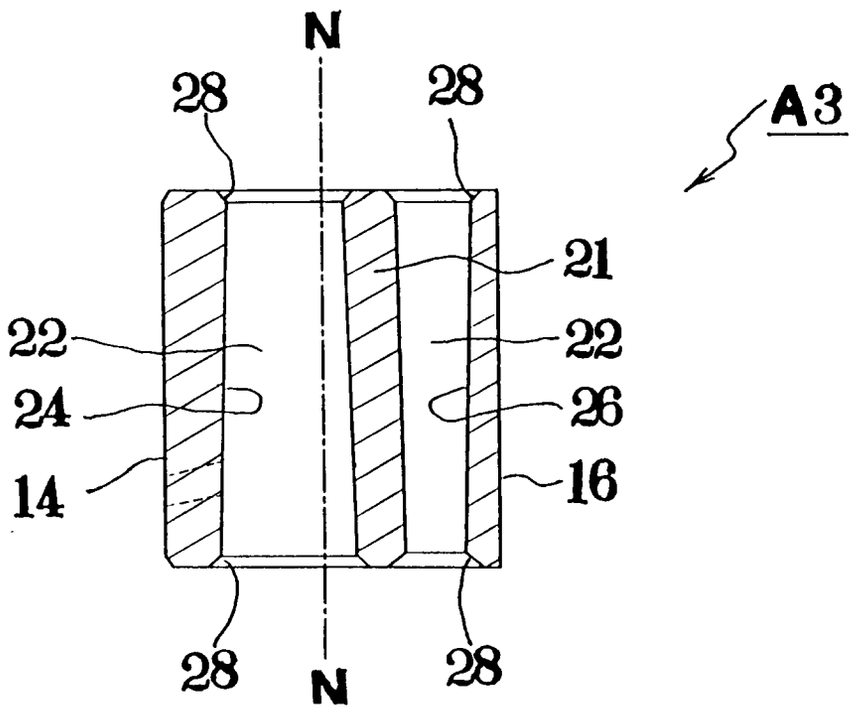

N
28
28
A3
21
22
22
24
26
14
16
28
N
28

FIG. 10

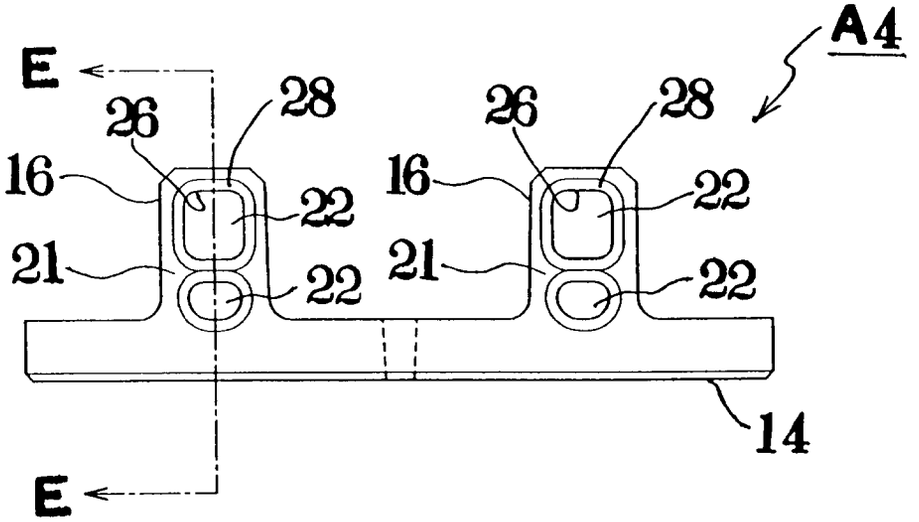

A4
E
26
28
26
28
16
22
16
22
21
22
21
22
14
E

FIG. 11

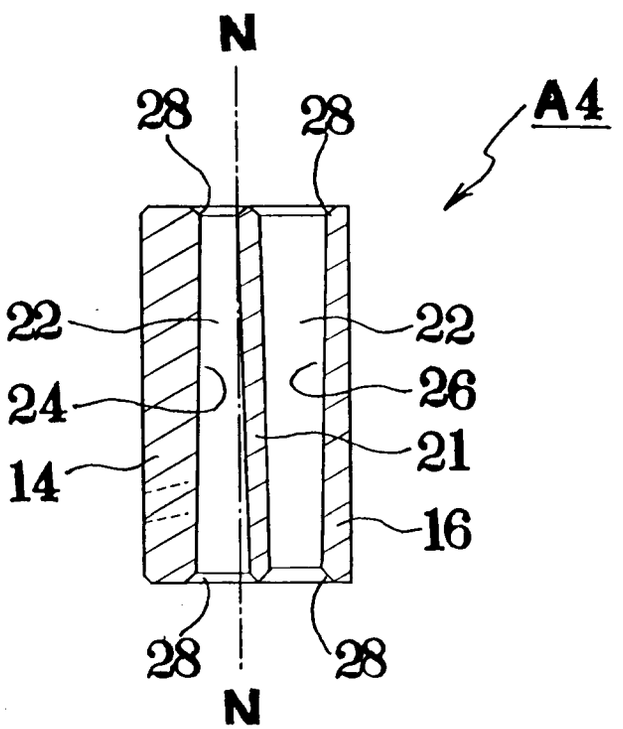

N
28
28
A4
22
22
24
26
21
14
16
28
28
N

FIG. 12

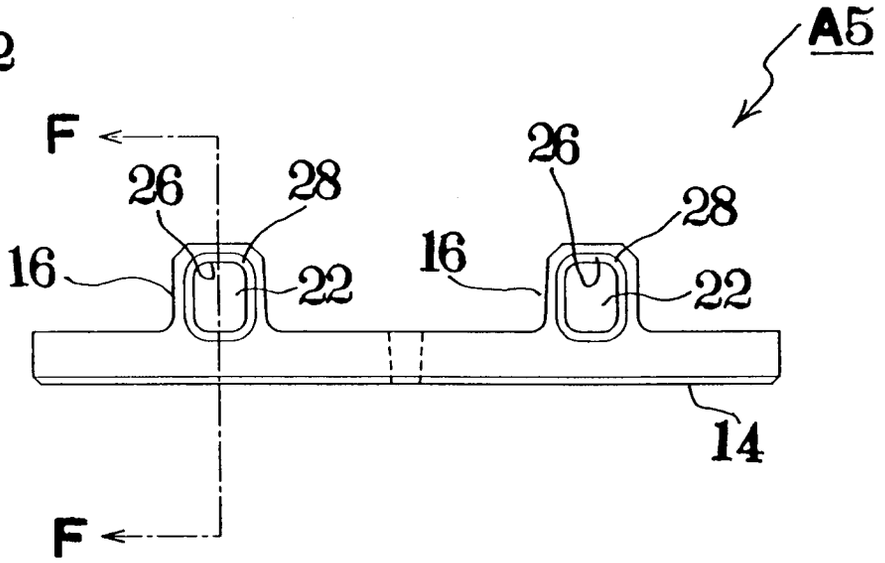


FIG. 13

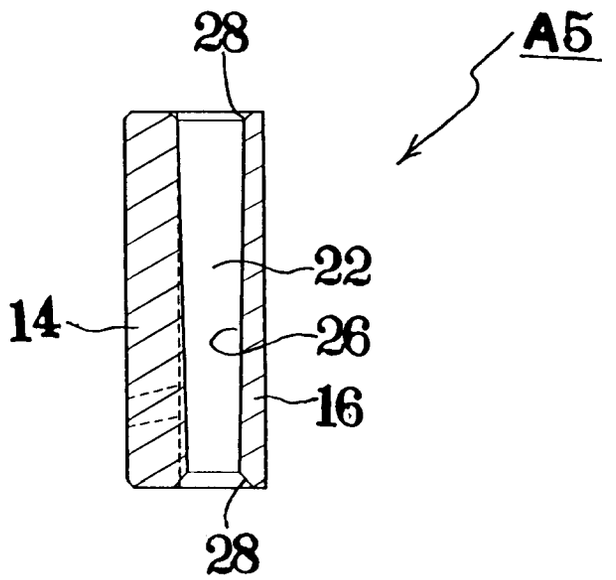


FIG. 14

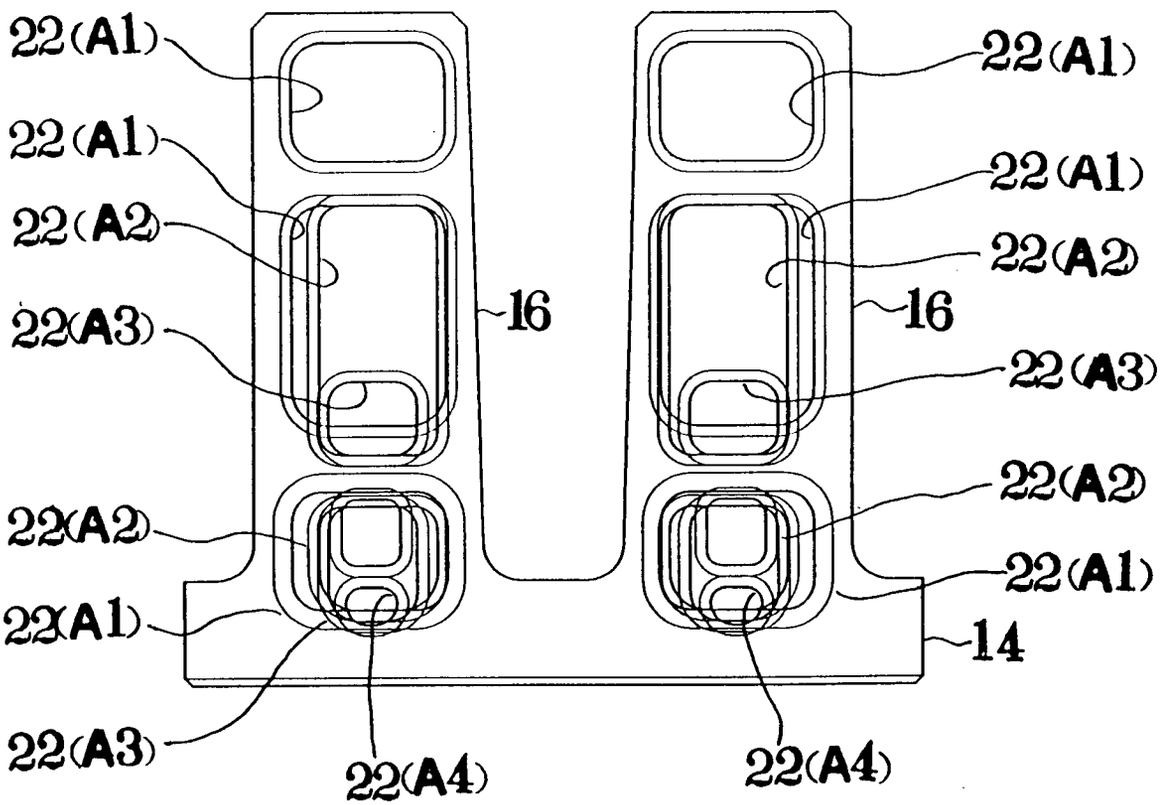

22(A1)
22(A1)
22(A2)
22(A3)
22(A2)
22(A1)
22(A3)
22(A4)
16
22(A1)
22(A1)
22(A2)
16
22(A3)
22(A2)
22(A1)
14
22(A4)

FIG. 15

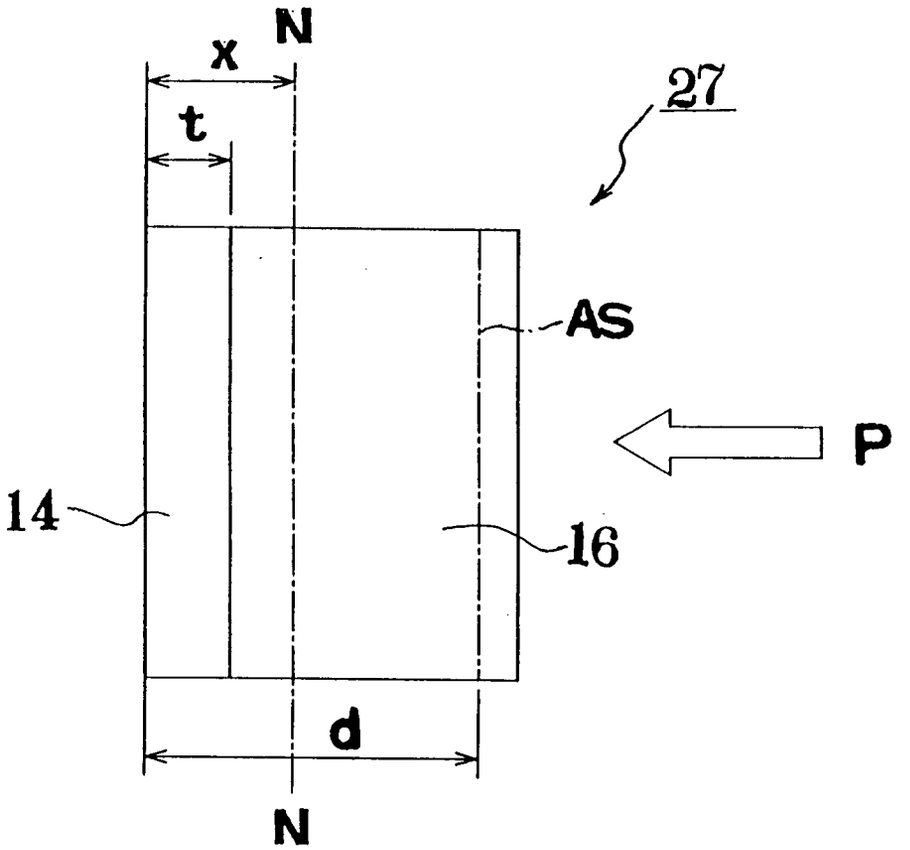

N
x
t
27
AS
P
14
16
d
N

FIG. 16

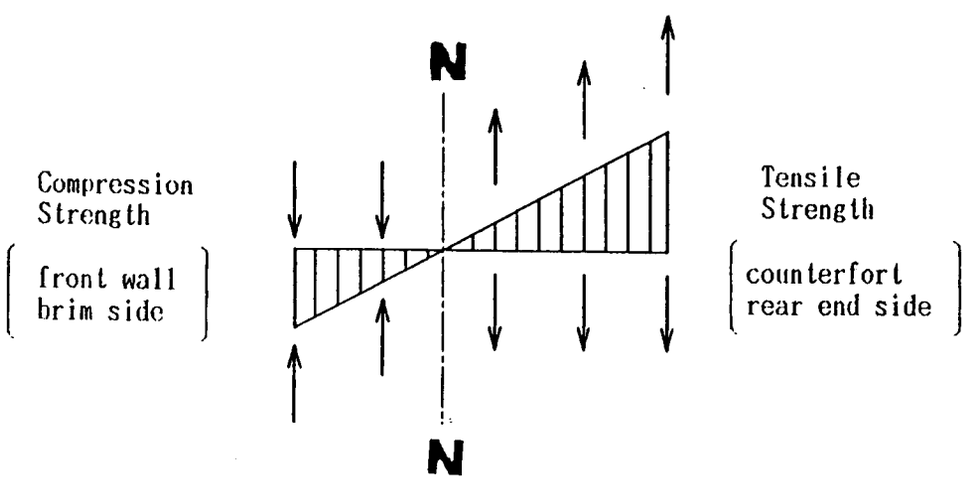

N
Compression Strength
front wall brim side
Tensile Strength
counterfort rear end side
N

FIG. 17

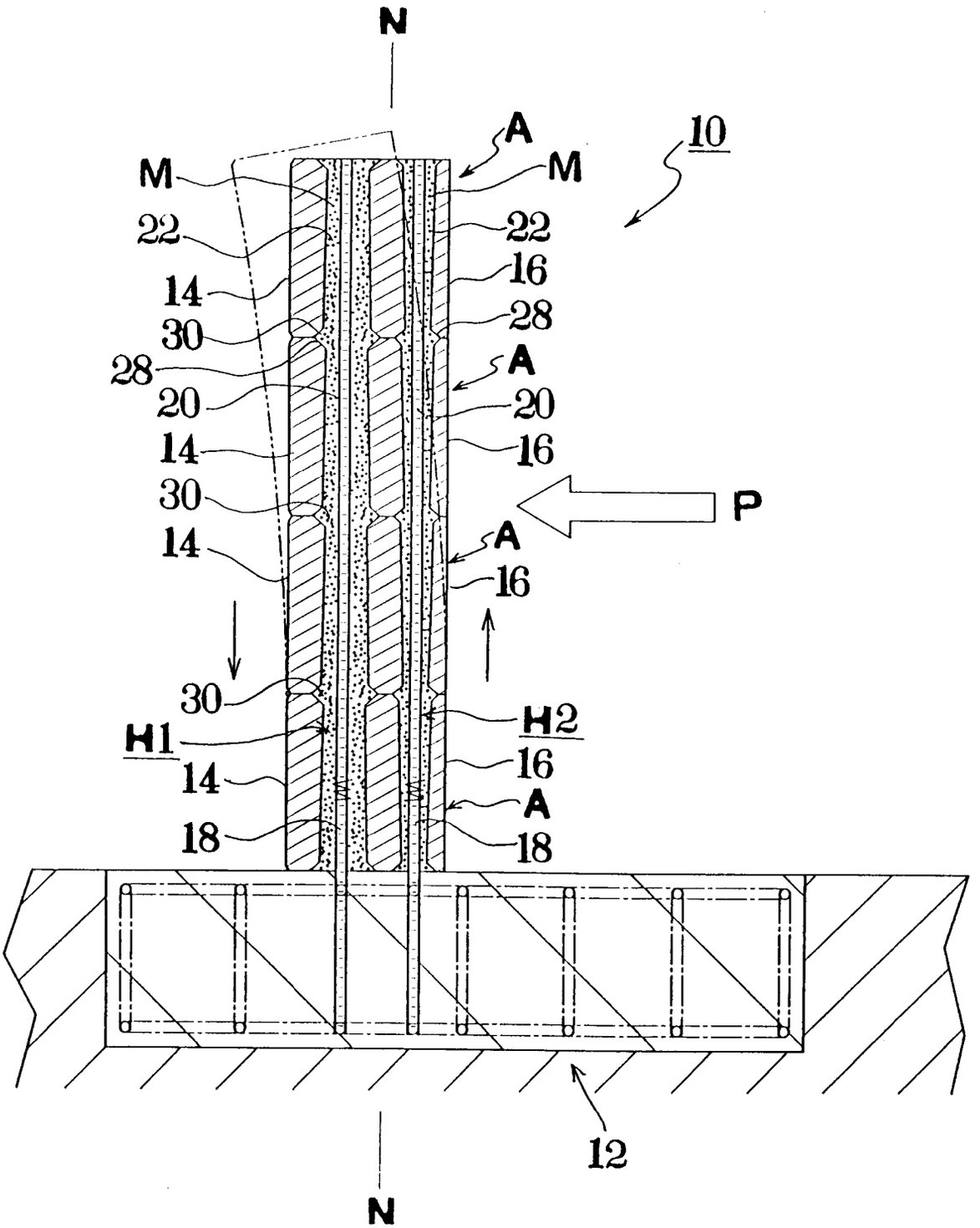

N
A
10
M
M
22
22
16
14
28
30
A
28
20
20
14
16
30
P
14
A
16
30
H2
H1
16
14
A
18
18
12
N

FIG. 18

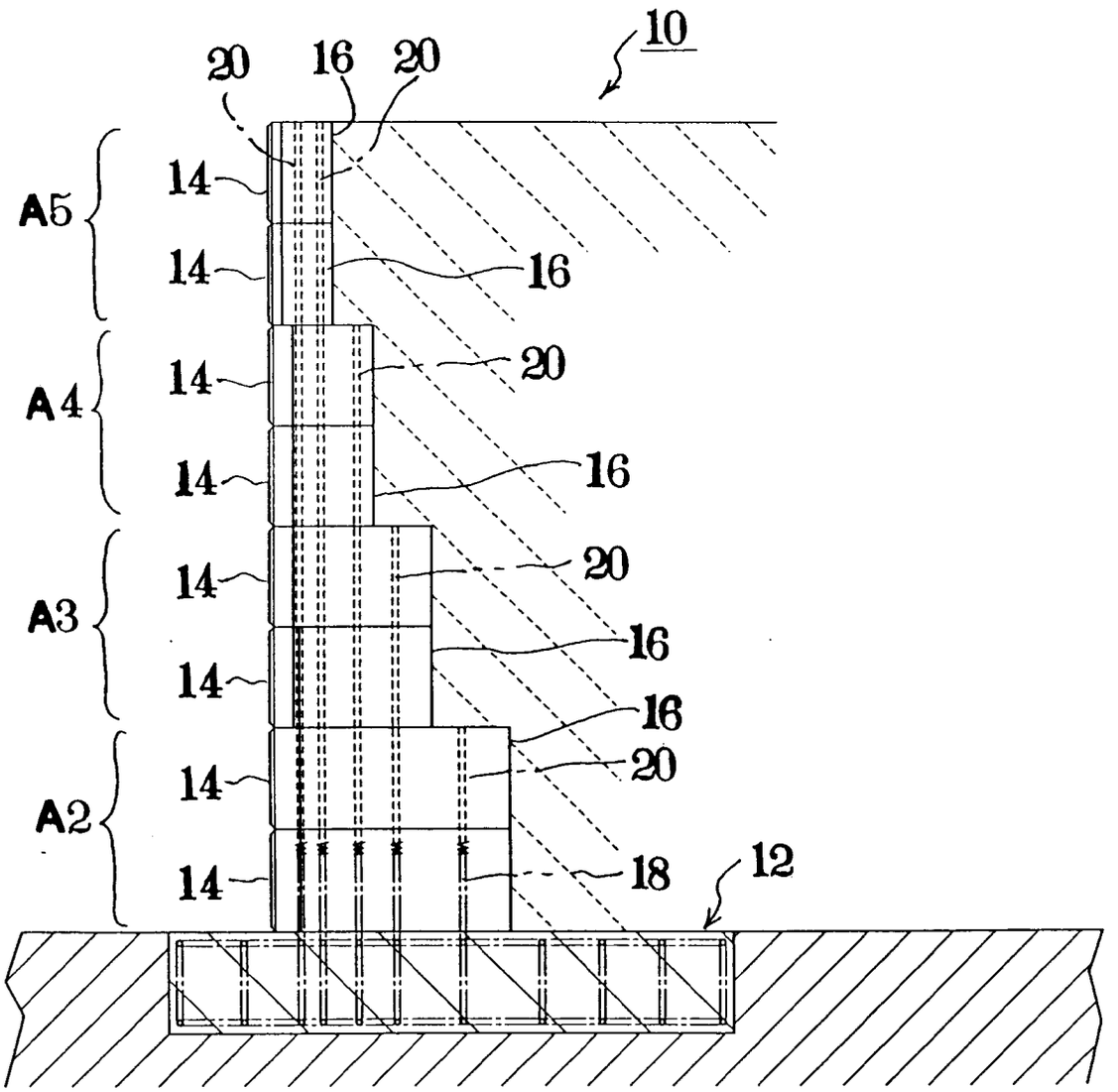
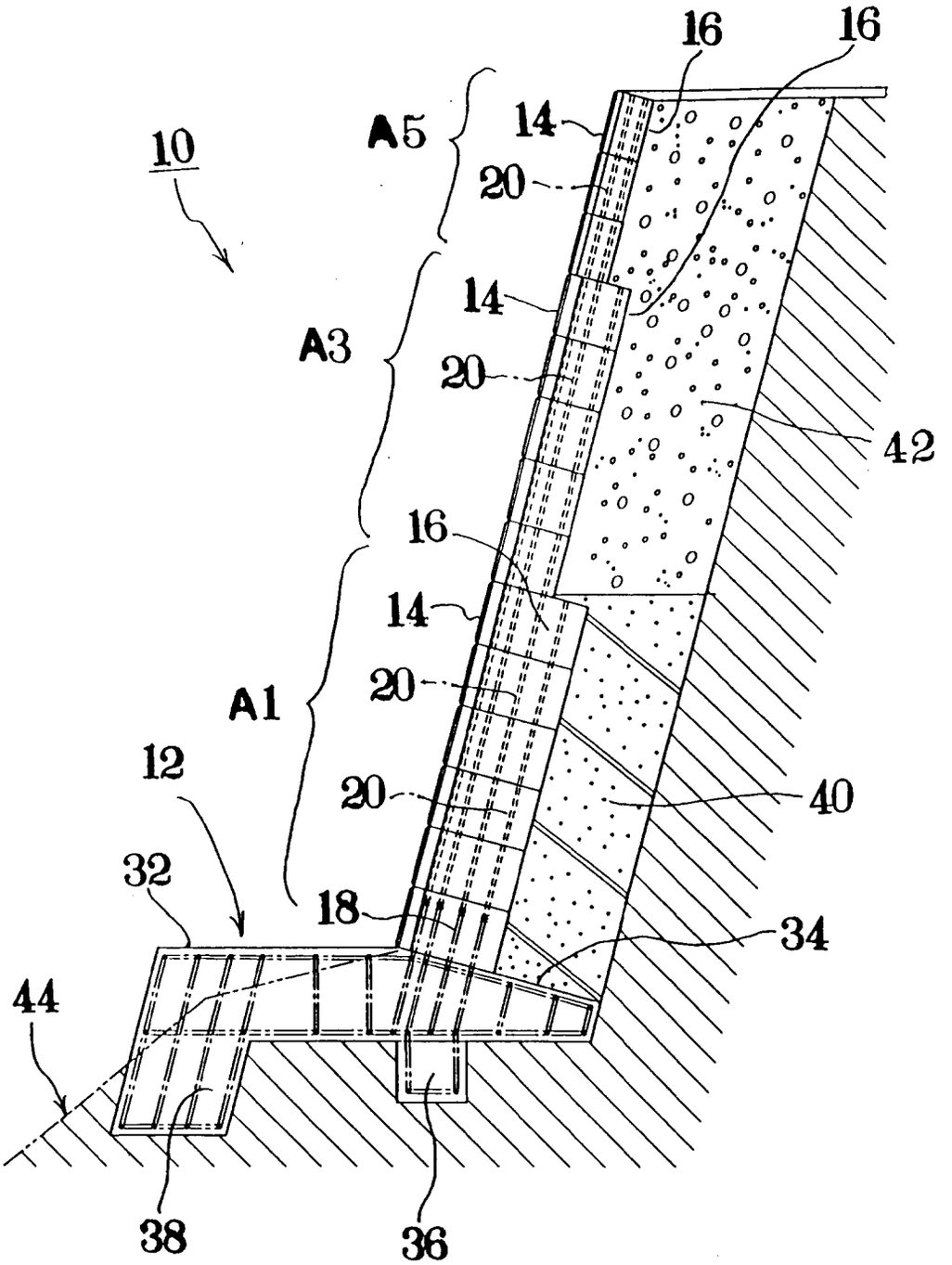


FIG. 19



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Application Number
EP 95 40 0635

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	PATENT ABSTRACTS OF JAPAN vol. 18 no. 360 (M-1634) ,7 July 1994 & JP-A-06 093626 (MASU KOUZOU KIKAKU KK) 5 April 1994, * abstract *	1-4	E02D29/02
Y	PATENT ABSTRACTS OF JAPAN vol. 007 no. 024 (M-189) ,29 January 1983 & JP-A-57 178032 (TOMIJI KOYAMA) 2 November 1982,	1-4	
A	* abstract *	5	
A	PATENT ABSTRACTS OF JAPAN vol. 010 no. 040 (M-454) ,18 February 1986 & JP-A-60 192030 (YUUKO AKAMINE) 30 September 1985, * abstract *	1-5	
A	CH-A-245 930 (LEEMANN) 16 August 1947 * page 1, line 13 - line 44 * * page 3, line 59 - page 4, line 10; figures 9-12 *	1-4	
A	US-A-1 909 539 (HUNTOON) 16 May 1933 * the whole document *	1-4	
A	PATENT ABSTRACTS OF JAPAN vol. 009 no. 294 (M-431) ,20 November 1985 & JP-A-60 133121 (HANEDA CONCRETE KOGYO KK) 16 July 1985, * abstract *	5	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 June 1995	Tellefsen, J

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