Title: METHOD AND APPARATUS FOR MANUFACTURING A REINFORCED CONSTRUCTIONAL ELEMENT, AND SUCH CONSTRUCTIONAL ELEMENT

Abstract

A method for manufacturing a constructional member, wherein a number of longitudinal elements which extend in at least one direction and which enhance at least the tensile strength of the constructional element in the or each relevant direction, are provided in a formwork (1) or a like mold cavity, after which the formwork (1) is further filled with a hardening slurry so that the longitudinal elements are surrounded by the slurry at least substantially on all sides, wherein the longitudinal elements are formed by discharging an amount of fibers (2) into the formwork, which fibers (2) have a relatively slight length and section compared with the inside dimensions of the formwork (1), wherein the loose fibers (2) are introduced into the formwork (1) with a slight height of fall, so that at least locally the fibers (2) are oriented in the desired direction of pull so as to be substantially parallel.
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Title: Method and apparatus for manufacturing a reinforced constructional element, and such constructional element.

The invention relates to a method according to the preamble of claim 1, for manufacturing a constructional element. Such a method is known from practice.

In order to increase the strength, in particular the tensile strength in one direction of a constructional member, it is known to include optionally pre-stressed reinforcement into for instance concrete constructions. Such reinforcement is typically manufactured from mild steel, which has a greater tensile strength than the concrete itself. A consequence of this known method is that the constructional member thus formed always contains cracks, which is disadvantageous to the durability of the material. The crack width directly depends on the thickness of the reinforcement used and the measure of covering of the reinforcement. The crack width can be limited through the use of relatively thin reinforcement and/or through increasing the coverage. A drawback of the use of thinner reinforcement, however, is that extremely thin reinforcement bars in particular are difficult to process, while precisely such reinforcement could minimize crack formation, and in particular the width thereof.

The object of the invention is to provide a method of the type described in the preamble of claim 1, wherein at least the tensile strength of a constructional member is increased in at least one direction, while crack formation in the constructional member is prevented or at least minimized,
while the width of any cracks that may occur in the constructional member is kept small and, moreover, continuation of beginning crack formation is quickly prevented. For that purpose, a method according to the invention is characterized by the features of the characterizing part of claim 1.

By using relatively short and thin fibers compared with the dimensions of the constructional member, a constructional member is obtained which has a high strength, stiffness and toughness. In the event of crack formation, the width of the crack is kept small owing to the very slight thickness of the fibers acting as reinforcement, while the crack formation is rapidly stopped as a result of the crack 'getting stuck' against an adjacent or nearby fiber. By orienting the fibers at least locally in a formwork in such a manner that the fibers extend substantially parallel to each other and in the desired direction of pulling, the tensile strength of the constructional member in that direction is considerably increased, due to the fact that when cracks get stuck, stress redistributions can occur and the section is used more efficiently.

In a constructional member manufactured according to the invention, in the case of beginning crack formation caused by, for instance, overload on the constructional member, crack formation in the constructional member is retarded owing to the large number of thin, short fibers. In constructional members manufactured according to the known method, cracking occurs suddenly, in a relatively short time, whereas in a constructional member according to the invention, crack
formation develops gradually and in a relatively long time. After all, breaking, cracking, deforming and/or loosening of fibers will occur substantially individually, while relatively much energy can be taken up, particularly if the fibers are positioned so as to be distributed over almost the entire surface of a cross section of the constructional member, which cross section extends at right angles to the direction of pulling. As a result, a constructional member according to the invention is safer in use, because sudden breaking is prevented. By introducing the fibers into the formwork with a slight height of fall, the fiber direction can easily be prevented from being adversely affected during falling, while the fibers can be provided in the formwork in a quick and cheap manner and in the desired direction of orientation.

In an advantageous embodiment, a method according to the invention is characterized by the features of claim 3.

By placing the fibers in strand-form on the bottom of the formwork and/or on comparable strands already provided, the orientation of the fibers can be locally determined in a particularly simple manner, enabling it to be chosen at any desired position in the formwork, and accordingly in the constructional element.

All strands can for instance be disposed parallel to each other in layers one above the other, resulting in a constructional element of a maximum tensile and compressive strength in one direction. Such a method is for instance particularly suitable for the manufacture of constructional members having an elongated shape which are to be loaded in a longitudinal
direction, such as bars in concrete trust girders and the like. Moreover, strands in one plane or in different planes lying one above the other may include an angle relative to each other, whereby the strength of the constructional member can be increased in two or more directions. For instance, strands can be arranged crosswise or in radial direction. Such a method is for instance particularly suitable for the manufacture of shell-shaped, flat and single or double-curved constructional members such as domed roof members and the like.

In an advantageous further embodiment, a method according to the invention is characterized by the features of claims 4 and 5.

The use of a filling apparatus having a filling opening which is at least height-adjustable offers the advantage that for each layer of fibers that is to be deposited in the formwork, the filling opening can always be set to the most suitable, minimum height of fall. The orientation of the fibers in each layer can thus be optimized in a simple manner. By choosing the height of fall to be less than at least the average and preferably less than the minimum length of the fibers to be discharged, the fibers are even more effectively prevented from assuming an orientation other than is desired during falling. As a result, the direction of the fibers can be determined very accurately at any position in the constructional member.

The invention moreover relates to a method according to claim 6.
By using this method, a space can be filled in an optimum manner, so that the volume share of fibers in the space can be chosen to be relatively large, for instance 20% or more. Thus, with such a stacking in a formwork for a constructional element, a stronger, better constructional element can be obtained. When such a method is used for filling a package, the advantage achieved is that less volume is necessary for storing and conveying an amount of fibers than in the case of known methods wherein fibers are discharged into a package loosely and in random orientation.

The invention further relates to a constructional member according to claim 7.

In an advantageous embodiment, a constructional member according to the invention is characterized by the features of claim 9.

By filling the formwork with fibers so that they extend in a priorly chosen direction essentially everywhere, a high degree of filling of the formwork is possible. By using a large share of fibers which, moreover, are optimally oriented, at least an optimum tensile strength of the constructional member is obtained in at least one direction. A constructional member having fibers for more than 10%, and preferably more than 20% of its volume, yields particularly strong constructional members, also in the case of filling material that, compared with the fiber material, is relatively brittle, such as concrete or cement, when tough fibers are used.

The invention moreover relates to an apparatus for use in a method according to the invention or in the manufacture of a
constructional element according to the invention. Such an apparatus is characterized by the features of claim 13.

Advantageous embodiments of a method, constructional element and filling apparatus according to the invention are described in the subclaims.

It is further observed that from practice a method is known for reinforcing concrete members, wherein an amount of fibers is loosely discharged into a formwork from a relatively great height. The formwork is filled to near the top edge, whereupon a hardening slurry, such as concrete slurry or cement slurry, is introduced into the formwork. The slurry is fluid so that it flows between the fibers and fills up all gaps completely. As a result, the fibers are surrounded by the slurry on all sides. With this known method, which is for instance practised for repairing floors or road surfaces, a concrete cover part is obtained having a relatively great resistance to wear. In this method, the fibers randomly extend in all directions.

To explain the invention, exemplary embodiments of methods, constructional members and filling apparatus will be described hereinafter, with reference to the accompanying drawings, wherein:

Fig. 1 is a top plan view of a formwork, partly filled with fibers, for a first exemplary embodiment of a constructional member;

Fig. 2 is a top plan view of a fiber-filled formwork for an alternative embodiment of a constructional member;
Fig. 3 schematically shows a first exemplary embodiment of a filling apparatus;

Fig. 3A shows a cross section of the filling apparatus according to Fig. 3;

Fig. 4 schematically shows a second exemplary embodiment of a filling apparatus;

Fig. 4A shows a cross section of the filling apparatus according to Fig. 4;

Fig. 5 schematically shows a third exemplary embodiment of a filling apparatus; and

Fig. 5A shows a cross section of the filling apparatus according to Fig. 5.

Fig. 1 shows a formwork 1 for a beam-shaped constructio-nal element, for instance a concrete prefab building element.

In the exemplary embodiment shown, the formwork 1 is built up of five planks and is box-shaped. The formwork has a relatively great length compared with the height and width. Of course, other shapes and constructions of formworks and like mold cavities are possible as well. By means of a filling apparatus 10, of which a number of exemplary embodiments are shown in Figs. 3-5, an amount of fibers 2 have been disposed on the bottom of the formwork and on each other. In proportion to the inside dimensions of the formwork, the fibers 2 have a very short length and a very small section. In this embodiment, the fibers 2 all extend parallel to each other in the longitudinal direction of the formwork and are discharged loosely into the formwork, in rows and layers. After the entire formwork has been filled with the fibers 2, for
instance 20-30% of the volume of the formwork is taken up by the fibers, the remaining space is open. Next, a filling material is introduced into the formwork in the form of a hardening slurry, for instance cast concrete or cement, which is sufficiently fluid for flowing in between the fibers. Accordingly, all space between and round the fibers 2 is filled up by the slurry, so that all fibers are completely embedded in the hardening slurry. During the hardening of the slurry, a proper adhesion is obtained between the fibers 2 and the filling material. As a result, during use, the fibers 2 act as longitudinal strength-enhancing reinforcing elements, while in the case of beginning crack formation, the fibers 2 provide that crack widths are only small, owing to the slight dimensions of the fibers, while moreover, the crack formation is stopped relatively quickly owing to the crack 'getting stuck' against an adjacent or nearby fiber or fibers. A constructional element manufactured according to this method has in particular a high tensile and compressive strength and a great toughness compared with constructional elements manufactured in a conventional manner. This can be appreciated as follows.

In the case of high load, in particular in the case of overload on the constructional element in the longitudinal direction, i.e. in the direction of orientation of the fibers 2, breaking will locally occur in the filling material of the constructional element. The forces are then locally transferred by the or each fiber that extends over that plane of fracture. According as the fracture proceeds further, more and
more fibers are loaded in tension. This involves the short, thin fibers being gradually and individually pulled loose, with friction, from the enclosure of the filling material, so that the crack formation and, possibly, breaking occurs very gradually only. Because the fibers are pulled loose, the width of the cracks remains limited, other than in cases where thick reinforcement bars are used. A crack reaching a nearby fiber will usually not proceed there, because at that location, the tension is essentially transferred via the fiber into the constructional element. This also causes the length of the cracks to remain limited. In a constructional element according to the invention, in the event of overload, a large number of thin, approximately parallel cracks are formed, rather than one or a limited number of wide cracks.

In the case of an unintended, slightly bending load on the constructional element, the distribution of the thin fibers over the entire plane of the cross section of the constructional element has the additional advantage that part of the fibers are located adjacent the outer side that is maximally loaded in tension, at a relatively large distance from the neutral line, so that the constructional element is also more resistant to such a load than a constructional element manufactured in the known manner, wherein the or each reinforcement bar is located at a relatively large distance from the outer surfaces of the constructional element, relatively close to the neutral line.

In a constructional element according to the invention, substantially all fibers contribute to the increase of the
tensile strength and the toughness of the constructional
element, owing to their orientation. In contrast, in the known
method for manufacturing fiber-impregnated concrete as is used
for floor and road surfaces, the fibers are oriented at
random. Consequently, only a small part of the volume is
filled with fibers, for instance 5-10%, while, moreover, only
part of those fibers extend in the desired direction of
pulling, statistically speaking considerably less than 30% of
the fibers. In addition, fibers extending in a direction which
includes an angle with the direction of pulling, will usually
be more likely to reduce the tensile strength of the construc-
tional element in the direction of pulling.

The following shapes, materials and dimensions of fibers
are given as an example and should not be given a limitative
interpretation. The fibers can for instance be wire-shaped or
cylindrical, 30 mm long with a section of 0.5 mm, or 75 mm
long with a section of 1 mm, and are manufactured from steel,
in particular mild steel, or tough plastic. Preferably, the
fibers are designed so that a proper adhesion to the filling
material is realized, for instance through texture or through
choice of material, or through the use of chemical components
or like adhesion-enhancing means.

Fig. 2 shows a formwork 3 for a shell-shaped building
component filled with fibers 2 which extend in a number of
layers one above the other in strands 4 crossing one another.
In the same manner as described hereinabove, the formwork 3 is
filled with fibers and next with the hardening filling
material. Because the fibers 2 extend string-shaped in crossing
strands, the strength of the constructional member is increased considerably in a number of directions. As a matter of fact, various comparable manners of filling are of course possible, for instance strands of fibers which lie crosswise in more or fewer directions of orientation and the like, in each case depending on the expected load pattern of the constructional member.

Figs. 3 and 3A show a first embodiment of a filling apparatus 10 suitable for use with a method according to the invention, for instance for manufacturing a constructional element as described hereinabove. The filling apparatus 10 comprises two substantially rectangular guide plates 11, which in the first position, shown in the drawing, are inclined relative to each other. The plates have a length and width which are considerably larger than the length of the fibers to be used. In the first position, the plates 11 contact each other along the bottom edge 12, while the top longitudinal edges 13 of the plates 11 are spaced apart a distance B, which distance is preferably larger than the length of the fibers 2 to be used. The plates 11 have a relatively smooth surface.

Adjacent the top longitudinal edge 13, each plate 11 comprises a supporting bracket 14, 15, mounted on the plate by a base part in such a manner that the legs 16, 17 of the supporting bracket 14, 15 extend next to the lateral sides 18 of the plates 11 and partly next to each other. The first supporting bracket 14 is O-shaped and has legs 16 of a length greater than the distance B between the top longitudinal edges 13, the second supporting bracket 15 is A-shaped has legs 17
which have the same length as the legs of the first supporting bracket 14. Adjacent the base part of the first supporting bracket 14, the legs 16, 17 are pivotally interconnected via a pivot 19. Disposed at the end remote from the pivot 19 is a connecting part 20, between the legs 16 of the first supporting bracket 14 and above and parallel to a connecting part 21 between the legs 17 of the second supporting bracket 15. Included between the two connecting parts 20, 21 is a resilient element 22 pressing the connecting parts 20, 21 apart, causing the plates 11 to be biased in the first position. Consequently, in the first position, the V-shaped space V enclosed by the plates is held closed at the bottom end.

Fibers 2 discharged between the plates 11 from the top end ricochet between the smooth plates 11 until they extend, adjacent the bottom longitudinal edges 12, on the bottom of the V-shaped space V in the longitudinal direction of the plates. In this connection, the longitudinal direction is understood to be parallel to the bottom longitudinal edges 12. As soon as a sufficiently thick layer of fibers 2 is formed on the bottom of the space V, for instance a layer of a thickness of some millimeters, the fibers can be discharged into a formwork. For that purpose, the apparatus 10 is moved, by the bottom longitudinal edge thereof, against or at least very closely above the bottom of the formwork or a layer of fibers 2 which is already located on the bottom, while the longitudinal direction of the plates is held in a desired direction within the formwork, for instance in the longitudinal
direction within the formwork according to Fig. 1. Then, the connecting parts 20, 21 are moved towards one another, against the spring pressure, whereby the bottom longitudinal edges 12 are moved apart and the fibers can fall from between the plates 11 in the second, open position, through a slight height. This height is preferably less than the average length of the fibers, in particular less than the minimum length of the fibers, which prevents the orientation of the fibers from being yet adversely affected during falling. A typical height, which should not be given a limitative interpretation, is between 0 and 20 mm.

After the fibers have left the space V via the open bottom end, the filling apparatus can be moved away upwards and/or in the longitudinal direction of the fibers 2, after which the connecting parts 20, 21 can be released and the plates 11 are pressed back into the first position. The filling apparatus 10 is then suitable for a next load of fibers which can for instance be contiguously deposited onto the strand of fibers priorly disposed in the formwork, parallel thereto or, for instance, transversely thereto.

Figs. 4 and 4A show a second embodiment of a filling apparatus according to the invention, which, at least as far as its construction is concerned, largely corresponds to the filling apparatus according to Figs. 3 and 3A. Identical parts have identical reference numerals. In this alternative embodiment, the plates 11 are not pivotally interconnected but can be pulled away upwards, each substantially parallel to its own plane. For that purpose, the plates 11, adjacent the top
ends thereof, are confined in a guiding apparatus 23, while between the plates a lifting apparatus 24 is provided whereby the plates 11 can be moved upwards. The guiding apparatus 23 each comprise, adjacent each lateral side 18 of each plate 11, four rollers 25, two rollers having their running surfaces against the relevant plate 11 within the space V, two rollers having their running surfaces against the side of the plate 11 that faces away from the space V. Adjacent each lateral side 18 of the plates 11, the lifting apparatus 24 comprises a yoke 26 having two transversely extending legs 27 which pass through holes 40 in the plates. Extending over each yoke 26 is a cover part 28 which is fixedly connected to the adjacent guiding apparatus 23. Included between the yoke 26 and the cover part 28 are resilient means 29 which bias the yoke 26 in the bottom, first position shown in Figs. 4 and 4A, with the bottom longitudinal edges 12 of the plates 11 abutting against each other and the V-shaped space V being closed.

After the space V has been filled with sufficient fibers 2, the yoke 26 can be pulled in the direction of the cover part 28, causing the legs 27 to take along the plates 11 upwards. As these plates move in their own planes, the bottom longitudinal edges 12 thus move upwards and apart, so that the space V is opened and the fibers can fall therefrom, without involving adjacent fibers being pushed away thereby or the plates getting stuck against the formwork. Hence, this embodiment is suitable in particular for use with a formwork wherein a series of strands of fibers are to be arranged next.
to or above one another, while the filling opening 12 can in each case be adjusted to the proper height.

The apparatus as shown in Figs. 3 and 4 can be used both in stationary condition and in discrete movement steps for filling in particular relatively small formworks. For use with relatively long formworks wherein elongated strands of fibers are to be arranged next to and over one another, a filling apparatus as shown in Figs. 5 and 5A is particularly suitable.

The filling apparatus as shown in Figs. 5 and 5A comprises two substantially circular plates 111, inclined relative to each other. Each plate 111 is mounted on a central rotary shaft 130 extending at right angles to the plane of the relevant plate 111. The plates 111 contact each other at the bottom end 112, while the top ends are spaced apart a distance B. Hence, a V-shaped space V is again enclosed between the plates 111. The two rotary shafts 130 are interconnected by a pull bracket 131 extending along the front side 118 of the plates 111. From the pull bracket 131, a slide plate 132 extends between the plates 111 to a position adjacent the bottom end 112, i.e. to a position adjacent the point of contact of the two plates 111. Hence, the space V is at least to the front side closed off by the slide plate 132. In this connection, the front side should be understood to be the side of the filling apparatus which, during use, leads in the direction of movement. The rotary shafts 130 can be connected to external drive means and the longitudinal edge of each plate 111 can be provided with a friction-enhancing running face.
The filling apparatus as shown in Figs. 5 and 5A can be used as follows.

The plates 111 are disposed on the bottom of the formwork or on fibers 2 located thereon, with the pull bracket 131 and the slide plate 132 at the front side. The filling apparatus is then pulled forwards across the bottom or the fibers, with the plates 11 acting as wheels and rotating in the pulling direction. At the same time, fibers are charged between the plates 111 from the top. These fibers ricochet between the plates 111 and the slide plate 132 until they have adopted the desired direction and end up at the bottom of the space V between the plates 111. From there, via the open back side, the fibers 2 slide in the desired direction of orientation from the space V into the formwork, in the shape of a strand.

In this manner, a strand of fibers 2 can be deposited in a continuous movement onto the bottom of the formwork or onto fibers already located thereon. The filling apparatus can be moved through the formwork a number of times, while in each case a next fiber strand is positioned, but a number of such filling apparatus can also be placed next to or behind one another and moved simultaneously through the formwork. In that manner, a series of fiber strands can be placed simultaneously.

In an alternative embodiment, not shown in the drawings, each rotary shaft 130 can be coupled to a carrying wheel. Each carrying wheel is located on the side of the relevant plate that faces away from the space V, and is adjustable relative to the rotary shaft in height and/or distance to the plate.
The carrying wheels can for instance find support on the edge of the formwork or on the ground, and be set so that the bottom end 112 of the plates 111 is located at a slight distance (for instance 0-20 mm) above the bottom of the formwork or above strands of fibers located thereon. This prevents the position of the fibers already present from being adversely affected by the rotating plates which are driven by the carrying wheels.

In a preferred embodiment, a coupling mechanism is provided between the plates respectively rotary shafts and the carrying wheels, whereby the position of the plates relative to the fibers in the formwork is automatically adjusted, for instance through adjustment thereof after each pass through the formwork.

In an alternative embodiment, not shown in the drawings either, a number of tubular or hose-shaped guide parts, for instance flexible hoses whose diameter is for instance smaller than the length of the fibers used, are at their top ends connected to a fiber-feeding apparatus, for instance a funnel-shaped element. The bottom ends of the hoses can be moved along or through the formwork. Fibers thrown into the funnel can only pass the guide part if they lie in the longitudinal direction and consequently, during use, they are introduced into the formwork in a longitudinally oriented position only.

An advantage of such an embodiment is that a relatively large number of discharge openings can be positioned close together at a relatively small width, enabling a formwork to be filled in a relatively small number of movements.
Filling apparatus and methods according to the invention are suitable for individual as well as industrial use.

The invention is by no means limited to the embodiments presented in the drawings and the specification. Many variations thereto are possible. For instance, various other patterns of fiber strands may be provided in one or several layers in various formworks. When the formwork is being filled with fibers, core parts may be included therein and the fiber strands may be disposed in bends along for instance core parts for holes to be formed in the constructional element. With a number of constructional elements according to the invention, relatively light and strong frames can be composed, for instance trusses and girders for supporting structures and coverings and piles. Actually, conventional reinforcement bars can also be included into the constructional elements, if so desired. The plates 11, 111 of the filling apparatus can be supported, guided and moved in various other manners. Moreover, vibrating means can be provided for simplifying the orienting of the fibers and/or for the further compacting thereof. These and many other adaptations are understood to fall within the framework of the invention.
1. A method for manufacturing a constructional member, wherein a number of longitudinal elements which extend in at least one direction and which enhance at least the tensile strength of the constructional element in the or each relevant direction, are provided in a formwork or a like mold cavity, after which the formwork is further filled with a hardening slurry so that the longitudinal elements are surrounded by the slurry at least substantially on all sides, characterized in that the longitudinal elements are formed by discharging an amount of fibers into the formwork, said fibers having a relatively slight length and section compared with the inside dimensions of the formwork, the loose fibers being introduced into the formwork with a slight height of fall, so that at least locally the fibers are oriented in the desired direction of pull so as to be substantially parallel.

2. A method according to claim 1, characterized in that as slurry, a concrete-bound or cement-bound slurry is used.

3. A method according to claim 1 or 2, characterized in that the amount of fibers are provided in the form of a strand, wherein a series of strands are placed next to and/or above one another within the formwork, wherein the orientation of the fibers in each strand is approximately identical, while different strands include an angle of between 0° and 90° relative to one another.

4. A method according to any one of claims 1-3, characterized in that a filling apparatus is used having a
filling opening which, during use, is at least adjustable in height relative to the bottom of the formwork, said filling apparatus being set so that the height of fall of the fibers corresponds to or is less than at least the average length and preferably the minimum length of the fibers.

5. A method according to claim 4, characterized in that the filling apparatus is moved in at least one direction through or over the formwork, wherein at least one strand of fibers is laid down in the direction of movement.

6. A method for filling a space with fibers, said fibers having a small length and section relative to the space, wherein the space is for instance bounded by a formwork for a constructional member or a package, characterized in that by means of a filling apparatus having a height-adjustable filling opening, the fibers with substantially the same direction of orientation are loosely discharged, with a relatively small height of fall compared with the length of the fibers, onto the bottom of the space or fibers located thereon.

7. A constructional member, manufactured by a method according to any one of claims 1-5.

8. A constructional member according to claim 7, characterized in that the fibers form at least 10% of the volume of the constructional member.

9. A constructional member according to claim 8, characterized in that the fibers form more than 20% of the volume of the constructional member.
10. A constructional member according to any one of claims 7-9, characterized in that the stiffness of the fibers is greater than the stiffness of the slurry in hardened condition.

11. A constructional member according to any one of claims 7-10, characterized in that the fibers are manufactured from metal, preferably steel.

12. A constructional member according to any one of claims 7-11, characterized in that the constructional member is beam-shaped, the fibers extending substantially in the longitudinal direction of the beam.

13. An apparatus for use with a method according to any one of claims 1-6 or for manufacturing a constructional member according to any one of claims 7-12.

14. An apparatus according to claim 13, characterized in that the apparatus comprises at least two plate members which are inclined relative to each other, wherein the plate members in a first position contact each other adjacent the bottom end, wherein adjacent the bottom end, the plate members in at least a second position determine an outlet opening for fibers, whilst fibers, during use, can be fed between the plates at the opposite end.

15. An apparatus according to claim 14, characterized in that the outlet opening has a width smaller than at least the average length and preferably the minimum length of the fibers to be used.
16. An apparatus according to claim 14 or 15, characterized in that means are provided for moving the plate members from the first position into the second position and vice versa.

17. An apparatus according to claim 16, characterized in that the plate members are substantially circular and rotatable around a shaft through the center, wherein the side between the plate members which, during use, leads, is closed off and wherein the first position of the plate members corresponds to the second position, the arrangement being such that during use the plate members can be rotatably moved relative to the formwork, the arrangement being such that fibers that are thrown from the top end between the plate members are, via the outlet opening, introduced strand-shaped into the formwork at the bottom end at the side which, in the direction of movement, trails.

18. An apparatus according to claim 16 or 17, characterized in that the plate members are pre-tensioned in the first position.

19. An apparatus according to claim 13, characterized in that at least one tubular or hose-shaped guide part is provided which at a top end thereof is connected to a filling apparatus and at the opposite end thereof has an outlet opening, the arrangement being such that fibers which, during use, are introduced into the filling apparatus are passed through the guide part and can be introduced, via the outlet opening, in a desired direction of orientation into a formwork or package.

20. A formwork or package according to the method of claim 6, filled with fibers.