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(54) Method and arrangement for making a fibre-reinforced unit

(57) A method of making a unit reinforced by means of magnetizable fibres comprising the steps of:
- providing a mixture of a binding agent and magnetizable fibres,
- providing a magnet device in the mixture,
- moving the mixture and the magnet device in relation to each other,
- under the influence of the relative movement of the mixture and the magnet device and the magnetic field of the magnet device, forming at least one series of fibres behind the magnet device,
- making the binding agent set after at least one series of fibres has been formed.

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Description

[0001] The present invention relates to a method of making units, particularly fibre-reinforced concrete units, especially involving fibres of a magnetizable material, such as steel. Such a method is known from German patent application 19.750.746. By this known method, a mixture including a hydraulic binding agent, such as, for example, concrete or mortar, is received in a mould. The mould filled with the mixture is subsequently fed through a coil which excites e.g. a parallel magnetic field. Under the influence of that parallel magnetic field all of the magnetizable fibres are then aligned in one and the same direction.

[0002] The advantage of such a unit provided with aligned fibres manifests itself in a higher resistance to bending loads and tensile loads. Randomly oriented fibres, too, present already improved mechanical properties for the unit, but these improvements are virtually the same in all directions. This is, however, not invariably an advantage for units to be loaded only in one direction or in a few directions. In such cases it would be desirable to utilize effectively the useful action of all fibres present in the constructional unit for the respective loads. In this connection it is therefore advantageous when the fibres are oriented in specific directions.

[0003] This known method has nevertheless drawbacks, too. So, it is true that the fibres in the known unit are uniformly oriented, but they still lie scattered over the cross section of the unit. However, in specific applications it is desirable to concentrate the fibres in definite areas, in the form of continuous series. By the known method this is impossible, since the magnetic field excited by the coil has inevitably a uniform effect on the fibres and consequently results in a uniform, regular distribution of the fibres.

[0004] It is therefore an object of the invention to provide a method by which, on the one hand, magnetizable fibres can be oriented in a desired direction in a mixture of a binding agent and such fibres, but by which, on the other hand, these fibres can be concentrated in specific areas. This object is reached by means of a method of making a constructional unit which is reinforced by means of magnetizable fibres, comprising the steps of:

- providing a mixture of a binding agent and magnetizable fibres,
- providing a magnet device in the mixture,
- moving the mixture and the magnet device in relation to each other,
- under the influence of the relative movement of the mixture and the magnet device and the magnetic field of the magnet device, forming at least one series of fibres behind the magnet device,
- making the binding agent set after at least one series of fibres has been formed.

[0005] The advantage of the method according to the invention is that now it is possible not only to orient the magnetizable fibres, but also to concentrate them. By this it is possible to form, so to speak, strings of fibres which have an effect analogous to that of reinforcement bars as known from concrete units of prior art. By means of such concentrated series of fibres, particularly steel fibres, it is possible to obtain a concrete unit of which the properties correspond more or less with those of a concrete unit in which there are conventional reinforcement bars. The advantage thereof is that the concrete unit according to the invention can also be applied as a replacement for the concrete units provided with reinforcement bars known in themselves.

[0006] By the method according to the invention, fibres present in the binding agent are pulled towards the magnet. As a result, the fibres eventually come to adhere to the magnet. The magnetized fibres sticking to the magnet, in turn, constitute points of attachment for further fibres, so that eventually a string of fibres comes into being. The frictional forces between the binding agent flowing along the strings and those fibres lead to it that, at a certain time, the lowermost fibres come loose and are "carried along" with the binding agent . This phenomenon occurs soon as the mentioned frictional forces are greater than the magnetic forces. After subsequent setting of the binding agent, the result is a concrete unit containing strings or series of fibres, which series of fibres have a highly favourable effect on the tensile strength and flexural strength of the respective concrete unit.

[0007] The magnet location in the cross section and its shape determine the location of the strings of fibres in the cross section of the concrete unit. As distinct from the method according to the state of the art, the orientation of the fibres in itself is not necessarily determined by the magnet. For the orientation takes place through the frictional forces between the binding agent and the fibres occurring during the difference in speed of the mixture in relation to the magnet.

[0008] The method according to the invention also comprises placing a cap on the upstream side of the magnet device. As a result of the presence of such a cap, which may be especially made of a material having no magnetizing action, the development of strings of fibres downstream of the magnet is even further improved.

[0009] As mentioned before, through the method according to the invention it is possible to obtain a finished building product in which there is a definite, desired reinforcement in the form of strings of fibres. The building product is obtained by making the binding agent set after the strings of fibres have been formed. For this purpose, the method according to the invention also comprises the step of making the mixture flow through a mould, or of moving upstream the mould and magnet to form the constructional unit. In the relevant mould, the binding agent is allowed to set and subsequently the finished product may be removed.

[0010] The method according to the invention can be implemented in many different ways associated with the

manufacture of different types of products, such as building products. So, the method according to the invention may comprise the application of an annular magnet or a set of magnets placed in a circle such that the mixture can flow within the annular magnet or the set of magnets placed in a circle between the binding agent and the fibres. With such an implementation of the magnet device annular shapes of strings of fibres can be obtained, in turn, resulting a certain desired reinforcing effect.

[0011] The method according to the invention is suitable for making not only e.g. pile-type constructional units, but also slab-type constructional units and the like. It is also feasible to make blocks.

[0012] The invention also relates to an arrangement for the implementation of the method described above, comprising a flow channel provided with a supply opening for feeding a mixture including a binding agent and magnetizable fibres, and also a magnet device being therein. On the upstream side of the magnet device there is preferably provided a cap of a non-magnetic material.

[0013] Finally, the invention relates to a product made by the method as described above.

[0014] The invention will be further explained with reference to an embodiment of the invention depicted in the figure. In the mould 1 schematically represented, a difference in speed 2 between a mixture consisting of a binding agent 3, such as concrete, and fibres 4, especially steel fibres on the one hand, and a magnet on the other hand, is brought about. In the present embodiment, a strong annular magnet 5 is included in the mould, such that either the mixture 3, 4 flows along the magnet 5 or the magnet is fed through the mixture. Upstream from the magnet 5 there is provided a cap made of a non-magnetic material (6).

[0015] Under the influence of the magnetic field excited by the annular magnet 5, the fibres 2 initially randomly distributed in the mixture 2 are concentrated to obtain strings 7 being downstream from the magnet 5 and in the beginning adhering to the magnet 5. Under the influence of the relative speed difference 2, these strings 7 are oriented in the direction of flow.

[0016] The strings 7 are exposed not only to magnetic forces, but also to frictional forces caused by the mixture 3, 4 flowing along the strings 7. As soon as these frictional forces increase, e.g. due to a lengthening of the strings 7, the lowermost fibres of these strings 7 get drawn loose and carried along with the flow 2 in the form of loose strings 8. The orientation of the strings 8 however remains the same as that of the strings 7 still attached to the magnet 5.

[0017] After the entire mould 1 has thus been filled with the mixture 3, 4 in which the fibres 4 originally randomly distributed now are concentrated in strings 8, the binding agent 3 is allowed to set. The finished concrete product then consists in a concrete body containing strings 8 of metal fibres 2 which extend in the longitudinal direction in the desired manner and have a favourable effect on the tensile strength and flexural strength.

[0018] Although a method by which a pile-type concrete product can be made is represented in the embodiment, the method is not limited to it. Through a suitable choice of the shape of the mould 1, the magnet 5 and a cap made of a non-magnetic material 6, e.g. a slab-type or a block-type concrete product or the like can be made.

Claims

1. Method of making a unit reinforced by means of magnetizable fibres (4), comprising the steps of:

   - providing a mixture of a binding agent (3) and magnetizable fibres (4),
   - providing a magnet device (5) in the mixture (3, 4),
   - moving the mixture (3, 4) and the magnet device (5) in relation to each other,
   - under the influence of the relative movement of the mixture (3, 4) and the magnet device (5) and the magnetic field of the magnet device (5), forming at least one series of fibres (7, 8) behind the magnet device (5),
   - making the binding agent (3) set after at least one series of fibres (7, 8) has been formed.

2. Method according to claim 1, which comprises carrying along, under the influence of the flow (2), at least one series of fibres (8) from the magnet device (5).

3. Method according to claim 1 or 2, which comprises placing a cap (6) on the upstream side of the magnet device (5).

4. Method according to claim 3, which comprises applying a cap (6) made of a non-magnetic material.

5. Method according to one of the preceding claims, which comprises making the mixture (3, 4) flow through a mould (1) for forming the unit.

6. Method according to claim 5, which comprises placing the magnet device (5) in or before the supply opening of the mould (1).

7. Method according to one of the preceding claims, which comprises applying an annular magnet or a set of magnets placed in a circle such that within the annular magnet or the set of magnets placed in a circle and the mixture are movable with respect to each other.

8. Method according to one of the preceding claims for making a pile-type unit.

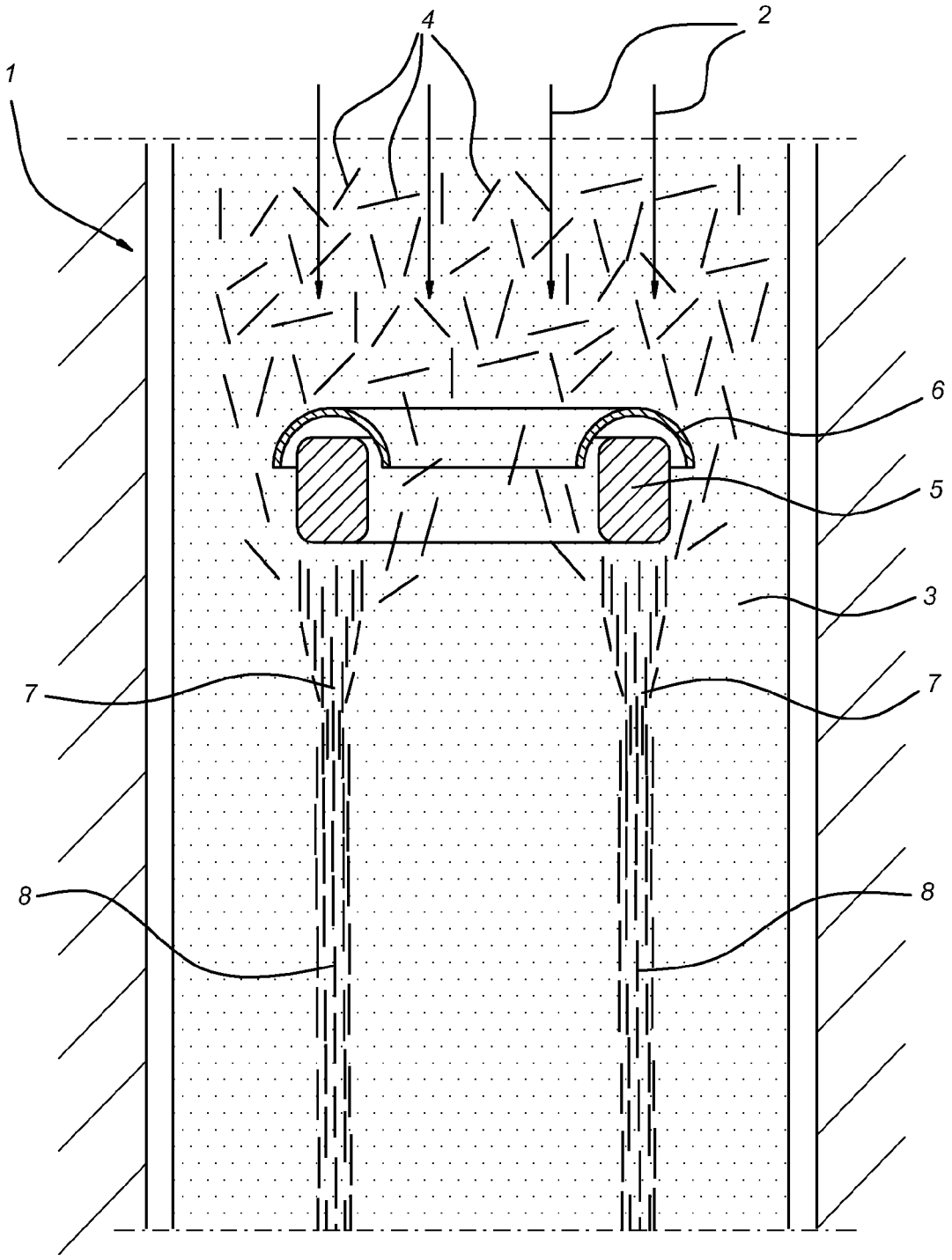
9. Method according to one of the claims 1-7 for making

a slab-type unit.

10. Arrangement for the implementation of the method according to one of the preceding claims, comprising a flow channel (1) provided with a supply opening for feeding a mixture of a binding agent (3) and magnetizable fibres (4), and also a magnet device (5) being therein.

11. Arrangement according to claim 10, comprising a cap, made of a non-magnetic material (6), on the upstream side of the magnet device (5).

12. Arrangement according to claim 10 or 11, in which the flow channel is part of a mould (1) for forming the unit.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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 19750746 **[0001]**