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(54) **A method and apparatus for manufacturing a concrete construction element**

(57) A method for manufacturing a concrete construction element (2) having hollow channels (4) comprises the steps of preparing a mould (12) in which channel recess elements (13) are provided for obtaining channels (4) in the construction element (2) to be made and pouring concrete into the mould (12). In the step of preparing the mould (12) a side recess element (15) is placed at a predetermined location outside at least one of the

channel recess elements (13) such that a side recess (7) in the resulting concrete element (2) is obtained at said location. The side recess element (15) has a minimum length which is smaller than the lengths of the hollow channels (4) of the resulting construction element (2) as seen in longitudinal direction thereof. The side recess element (15) has a minimum width which is smaller than the width of the resulting construction element (2) as seen in transverse direction thereof.

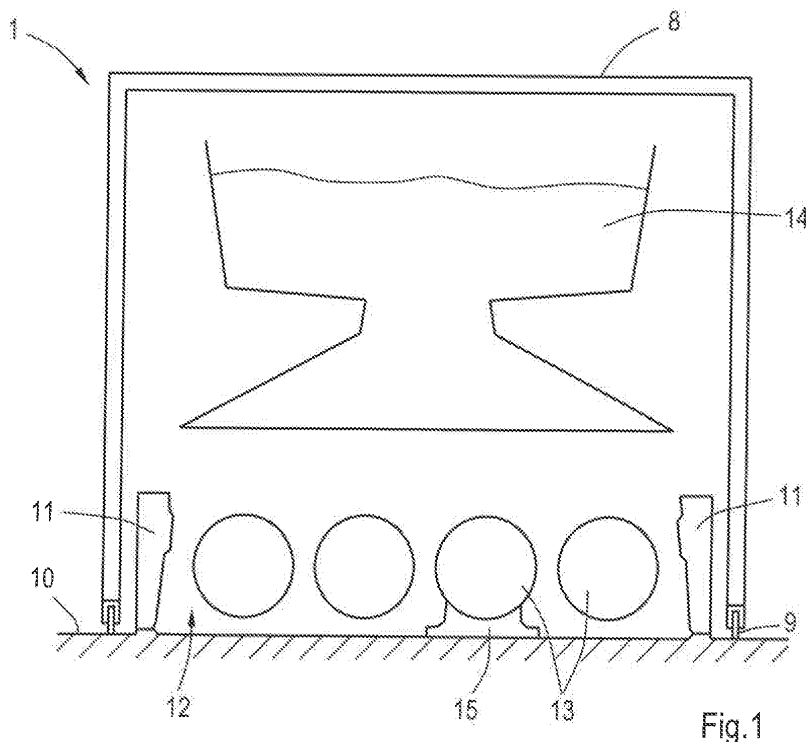


Fig.1

Description

[0001] The present invention relates to a method for manufacturing a concrete construction element having hollow channels, comprising the steps of preparing a mould in which channel recess elements are provided for obtaining channels in the construction element to be made and pouring concrete into the mould.

[0002] Such a method is known in the art. In the known method the mould is formed by a work floor, opposite upright walls and channel recess elements. The concrete is poured into the mould whereas the channel recess elements are moved in horizontal direction parallel to the work floor. As a result, the resulting concrete construction element is provided with elongated hollow channels. The construction element is typically suitable for applying as part of a system floor in a building. In practice the hollow channels cause a lower weight of the construction element. Furthermore, the channels can also be used as transport means for transport purposes, for example as ducts in a ventilating system or as tubes for wiring and cables for electrical and data systems.

[0003] It is an object of the present invention to provide a method for manufacturing a concrete construction element which needs limited treatment after installing in a building.

[0004] To obtain this object, in the step of preparing the mould a side recess element is placed at a predetermined location outside at least one of the channel recess elements such that a side recess in the resulting concrete element is obtained at said location, wherein the side recess element has a minimum length which is smaller than the lengths of the hollow channels of the resulting construction element as seen in longitudinal direction thereof, and wherein the side recess element has a minimum width which is smaller than the width of the resulting construction element as seen in transverse direction thereof.

[0005] Due to these features the work that is necessary to make an opening in the concrete construction element to one of the desired hollow channels is minimized or even eliminated. For example, drilling a hole in such a construction element after it has been installed in a building is unpleasant and requires time. When the side recess is used for connecting a duct to a hollow channel it is advantageous to be able to fit a duct or the like into the construction element at the side recess without extensive preparation of the side recess. Furthermore, minimized finishing the construction element after having installed it in a building improves the quality thereof.

[0006] It is noted that the longitudinal direction of the resulting construction element is the same direction as the longitudinal direction of the hollow channels. In practice the construction element will be longer in its longitudinal direction than in its transverse direction, but this is not necessary. The shape and dimensions of the side recess element may vary as seen in vertical cross-section of the mould. This will also affect the shape and di-

mensions of the side recess of the resulting construction element. Considering vertical cross-sections of the resulting construction element it will be seen that a minimum width of the side recess is smaller than the width of the construction element in transverse direction and that a minimum length of the side recess is smaller than the length of the hollow channel in longitudinal direction.

[0007] In a preferred embodiment the side recess element is placed such that the resulting side recess substantially communicates with at least one of said resulting channels. The advantage of this embodiment is that after installing the resulting construction element it is not necessary to open a wall between the side recess and the corresponding channel. In practice there may be a tiny concrete layer between the side recess and the corresponding hollow channel.

[0008] The side recess element may be placed such that the resulting side recess has an opening at the outer side of said resulting construction element. In this case the construction element has already an opening to which parts can be connected from outside the construction element after installing this. If the resulting side recess also communicates with the corresponding hollow channel the hollow channel can be easily connected to an external piping system such as a ventilating system. It may be unnecessary, for example, to drill a hole into the concrete construction element to a desired channel.

[0009] The side recess element may have a conical shape which narrows towards the channel recess elements. This may facilitate to fit connecting elements to the side recess of the resulting construction element. Nevertheless, numerous alternative shapes are conceivable.

[0010] The side recess element may have a provision, for example a ridge, for attaching ventilation parts or lighting parts. In this way the normally used fixing systems are not necessary.

[0011] The side recess element may be adapted such that the resulting side recess comprises fastening means for fastening external parts to the resulting construction element. For example, the side recess includes a snap fitting for easily fitting a tube into the recess, or the shape of the side recess is such that external parts can be easily attached to the construction element at the side recess.

[0012] In a practical embodiment the mould has a bottom on which the concrete is poured, wherein the side recess element is attached to the bottom in the step of preparing the mould. In this case the resulting construction element will obtain a lower wall which has the mirrored contour of the bottom and a side recess element.

[0013] Preferably, the side recess element is releasably attached to the bottom in the step of preparing the mould, since this provides the opportunity to use the same mould several times whereas the recess element may be placed at different locations on the bottom. In practice a building may use similar basic concrete construction elements but the side recesses may be desired at different locations in the construction elements.

[0014] The side recess element may be fixed to the bottom by means of magnetic force. For example, the bottom of the mould may be made of steel whereas the side recess element is made of a magnetic material.

[0015] The channel recess elements and/or the side recess element may be removed from the resulting construction element after the step of pouring concrete. This means that the elements can be used more than once.

[0016] In a practical embodiment the steps of preparing the mould and pouring concrete are performed simultaneously whereas the mould is at least partly moved in a manufacturing direction. This provides the opportunity to manufacture a relatively long concrete element by means of short mould parts. In practice the channel recess elements may be moved during the steps of preparing the mould and pouring simultaneously. In this case the side recess element is placed outside the paths that are followed by the channel recess elements.

[0017] In the step of preparing the mould, tubes and/or reinforcement bars may be provided within the mould, wherein the tubes and/or reinforcement bars are omitted at the side recess element. Already during the step of preparing the mould it is possible to avoid that a tube or reinforcement bar extends through the side recess of the finished construction element. Therefore, the method according to the invention creates a great flexibility of locating the side recess, hollow channels, tubes, reinforcement bars or other additional parts with respect to each other.

[0018] In general, the side recess element may be located at the same height level as prestressing tendons in the mould. It is however possible that the side recess element is located at an alternative location, for example between an outer channel recess element and a side wall of the mould, or above the channel recess elements.

[0019] The invention is also related to an apparatus for manufacturing a concrete construction element having hollow channels, comprising a mould in which channel recess elements are present for obtaining channels in the construction element to be made, wherein a side recess element is located within the mould at a predetermined location along and outside at least one of the channel recess elements so as to create a hollow space in a construction element to be made at the side recess element, wherein the side recess element has a minimum length which is smaller than the lengths of the hollow channels of the resulting construction element as seen in longitudinal direction thereof, and wherein the side recess element has a minimum width which is smaller than the width of the resulting construction element as seen in transverse direction thereof.

[0020] The channel recess elements may be movable along the side recess element.

[0021] The invention will hereafter be further explained with reference to the drawings showing embodiments of the method and apparatus according to the invention by way of example.

[0022] Fig. 1 is a front view of an embodiment of an

apparatus for manufacturing a construction element according to the invention.

[0023] Fig. 2 is a cross-sectional view of a construction element which is manufactured by means of an embodiment of the method according to the invention.

[0024] Concrete construction elements including longitudinal hollow channels are usually manufactured in great length, for example 150 m, and cut afterwards in shorter elements of for example 5 m, but shorter or longer elements are conceivable. Fig. 1 shows a front view of an embodiment of an apparatus 1 for manufacturing a concrete construction element according to the invention and Fig. 2 shows a cross-section of a concrete construction element 2 which is manufactured by means of an embodiment of the method according to the invention.

[0025] The construction element 2 can be used as part of a system floor. A lower side 3 of the construction element 2 may function as a ceiling of a room. The construction element comprises a plurality of elongated hollow channels 4, which extend in longitudinal direction of the construction element 2. The channels 4 are separated by channel walls 5. Close to the lower side 3 of the construction element 2 are a plurality of reinforcement bars 5. The embodiment of the construction element 2 as shown in Fig. 2 is also provided with tubes or pipes 6 for conducting heating or cooling fluid after the construction element 2 has been installed in a building. This configuration appears to be advantageous in terms of climate control.

[0026] Furthermore, the construction element 2 also comprises a side recess 7 which communicates with one of the channels 4.

[0027] In practice the side recess 7 can be used as a ventilation hole when the corresponding channel 4 functions as a ventilation duct in a ventilating system of a building, but numerous alternative applications are conceivable. The side recess 7 may have several shapes, but will be shorter than the length of the channels 4 as seen in longitudinal direction of the element 2. It is also conceivable that the side recess 7 communicates with more than one of the channels 4.

[0028] It is possible to create the side recess 7 or ventilation hole after installing the construction element 2 in a building, for example by means of drilling. In the method according to the invention the side recess 7 is advantageously created during manufacturing the construction element 2. Fig. 1 illustrates an embodiment of an apparatus 1 for manufacturing the construction element 2. The apparatus 1 comprises a frame 8 which can be moved by means of wheels 9 over a work floor 10. The wheels 9 are located on lateral sides of the frame 8. On the work floor 10 two opposite mould parts 11 are located at a predefined distance from each other between which concrete can be poured. The contours of the mould parts 11 define the shapes of sidewalls of the resulting construction element 2. Both upright mould parts 11 and the bottom or work floor 10 form part of a mould 12.

[0029] Before pouring concrete into the mould 12 it is

prepared by supplying channel recess elements 13 for obtaining the hollow channels 4 in the construction element 2 to be made. The channel recess elements 13 are elongated bodies that are fixed to the frame 8. The length of a channel recess element 13 may be 1 m, for example, but a longer or shorter channel recess element 13 is conceivable. During the manufacturing process the frame 8 including the channel recess elements 13 move continuously forward and concrete is supplied to the mould 12 simultaneously by means of a concrete-pouring system 14 which is also fixed to the frame 8. As a consequence, at the rear side of the apparatus 1 the construction element obtains a cross-section as shown in Fig. 2. Due to the continuous manufacturing process the channel recess elements 13 are removed from the resulting construction element 2 after the step of pouring concrete. It is noted that the process is illustrated and described in a simplified way, but in practice it may be a more complicated two-step process. The apparatus 1 may be provided with compacting members (not shown) for compacting the concrete. The compacting members may comprise vibrating elements so as to fluidize the concrete.

[0030] The reinforcement bars 5 and/or pipes 6 may lay on the work floor 10 before the frame 8 including the channel recess elements 13 and the concrete-pouring system 14 pass. The reinforcement bars 5 and/or pipes 6 may be taken up by the frame 8 such that they have a desired location within the mould 12 when concrete is poured into the mould 12.

[0031] In order to create the side recess 7 in the construction element 2 during the manufacturing process a side recess element 15 is placed within the mould 12 at a predetermined location along one of the channel recess elements 13. The minimum length of the side recess element 15 is smaller than the lengths of the hollow channels 4 and the pipes 6 and reinforcement bars 5 of the resulting construction element 2. The minimum width of the side recess element 15 is smaller than the width of the resulting construction element 2 as seen in transverse direction of the hollow channels 4. As illustrated in Fig. 1 the channel recess elements 13 pass the side recess element 15 whereas concrete is poured into the mould 12. As a result the side recess 7 is obtained in the resulting construction element 2.

[0032] The side recess element 15 may be placed such that the resulting side recess 7 communicates with the corresponding channel 4. However, it is also conceivable that a thin concrete layer is present between the side recess 7 and the corresponding channel 4, which layer has to be pierced after installing the construction element 2 in a building.

[0033] In the embodiment as shown in Fig. 1 the side recess element 15 is placed on the work floor 10. As a consequence, the resulting side recess 7 has an opening in the lower side 3 of the resulting construction element 2. This is illustrated for one embodiment in Fig. 2. In the embodiment as shown in Fig. 2 the side recess 7 narrows

towards the corresponding channel 4. However, numerous alternative shapes are conceivable, for example conical.

[0034] The side recess element 15 as shown in Fig. 1 and the side recess 7 as shown in Fig. 2 illustrate that the horizontal distance between the outer walls of the side recess element 15 and the side recess 7 varies in height direction as seen in transverse cross-section of the resulting construction element 2. Nonetheless, the minimum width of the side recess element 15 and the side recess 7 are smaller than the distance between the upright mould parts 11, i.e. smaller than the width of the resulting construction element 2.

[0035] Since it is preferred to use the work floor 10 several times the side recess element 15 is releasably attached to the work floor 10. In this case the work floor 10 is made from metal and the side recess element 15 is made of a magnetic material such that the side recess element 15 is attached to the work floor 10 by means of magnetic force.

[0036] In the embodiment as shown in Fig. 2 the side recess element 15 is removed from the resulting construction element 2 after the step of pouring concrete, but it is also possible that it stays in the construction element 2.

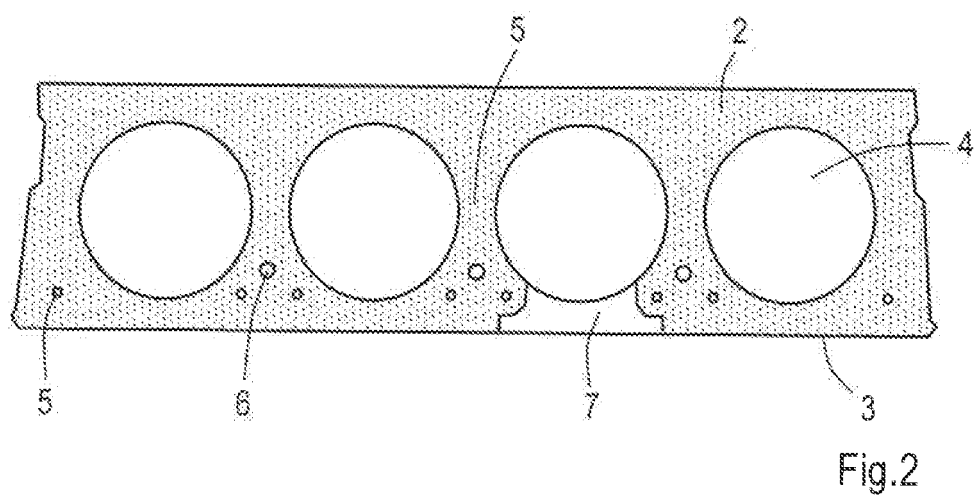
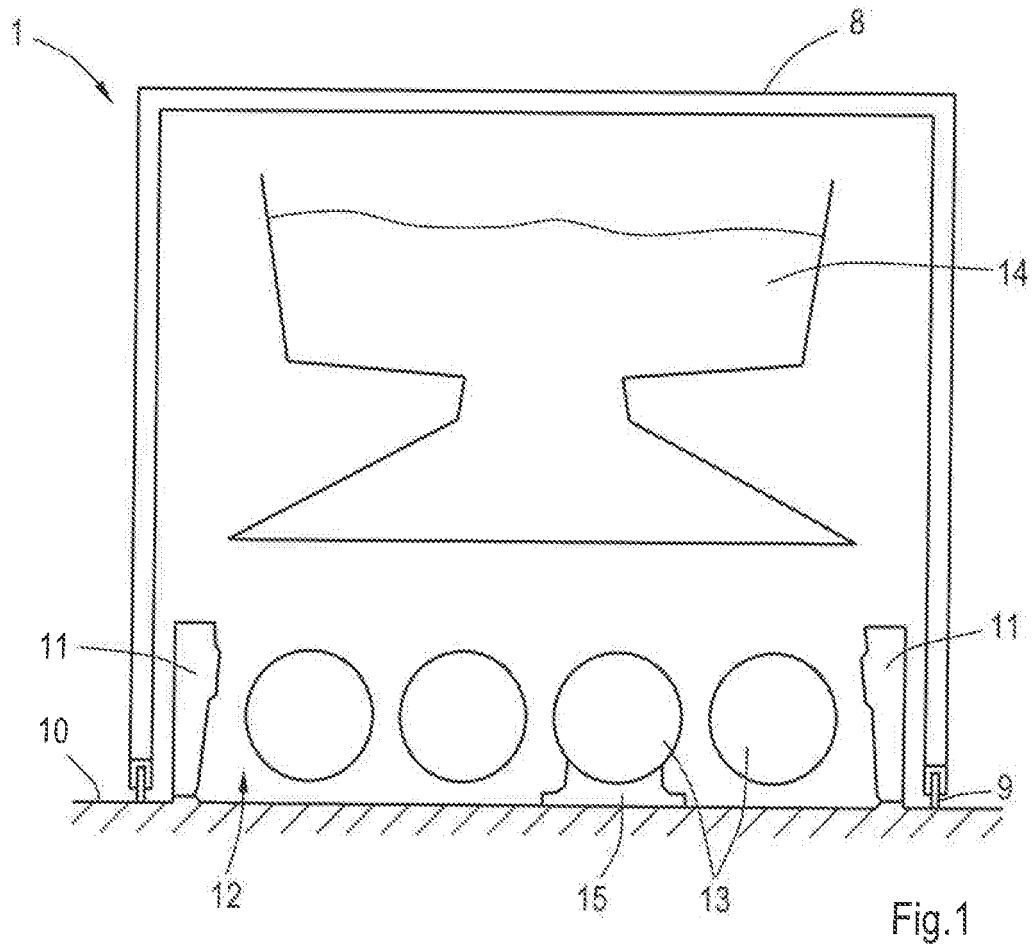
[0037] In practice the tubes 6 and/or reinforcement bars 5 are laid on the work floor 10 before pouring. The frame 8 may be provided with a take-off member (not shown) that lift the tubes 6 and/or reinforcement bars 5 from the floor just before pouring. It is also conceivable to place the tubes 6 and/or reinforcement bars 5 on distance holders (not shown) on the work floor 10 before moulding. If the desired location of the side recess element 15 is known the tubes 6 and/or reinforcement bars 5 can be located such that they extend outside the side recess element 15.

[0038] The invention is not restricted to the above-described embodiments, which can be varied in a number of ways within the scope of the claims. For instance, it is conceivable that the steps of preparing the mould and pouring concrete are successive steps. It is also possible to apply more than one side recess in one construction element. Furthermore, the side recess or the side recess element may be provided with fixing means, for example snap elements, which after installing of the construction element enable easy coupling of ducts into the side recess or into the side recess element if this is not removed from the construction element. It is also possible that the mould is prepared such that the side recess element is not placed between the bottom and the channel recess elements, but at a location next to the channel recess elements as seen from above, or at a location above the channel recess elements.

Claims

1. A method for manufacturing a concrete construction

- element (2) having hollow channels (4), comprising the steps of preparing a mould (12) in which channel recess elements (13) are provided for obtaining channels (4) in the construction element (2) to be made and pouring concrete into the mould (12), **characterized in that** in the step of preparing the mould (12) a side recess element (15) is placed at a predetermined location outside at least one of the channel recess elements (13) such that a side recess (7) in the resulting concrete element (2) is obtained at said location, wherein the side recess element (15) has a minimum length which is smaller than the lengths of the hollow channels (4) of the resulting construction element (2) as seen in longitudinal direction thereof, and wherein the side recess element (15) has a minimum width which is smaller than the width of the resulting construction element (2) as seen in transverse direction thereof.
2. A method according to claim 1, wherein the side recess element (15) is placed such that the resulting side recess (7) substantially communicates with at least one of said resulting channels (4).
 3. A method according to claim 1 or 2, wherein the side recess element (15) is placed such that the resulting side recess (7) has an opening at the outer side of said resulting construction element (2).
 4. A method according to claim 3, wherein the side recess element (15) has a conical shape which narrows towards the channel recess elements (13).
 5. A method according to claim 3 or 4, wherein the side recess element (15) is adapted such that the resulting side recess (7) comprises fastening means for fastening external parts to the resulting construction element (2).
 6. A method according to one of the preceding claims, wherein the mould (12) has a bottom (10) on which the concrete is poured, and wherein the side recess element (15) is attached to the bottom (10) in the step of preparing the mould (12).
 7. A method according to one of the preceding claims, wherein the side recess element (15) is releasably attached to the bottom (10) in the step of preparing the mould (12).
 8. A method according to claim 6 or 7, wherein the side recess element (15) is attached to the bottom (10) by means of magnetic force, adhesive, or using textured formsheets.
 9. A method according to one of the preceding claims, wherein the channel recess elements (13) and/or the side recess element (15) are removed from the resulting construction element (2) after the step of pouring concrete.
 10. A method according to one of the preceding claims, wherein the steps of preparing the mould (12) and pouring concrete are performed simultaneously whereas the mould (12) is at least partly moved in a manufacturing direction.
 11. A method according to claim 10, wherein the channel recess elements (13) are moved.
 12. A method according to one of the preceding claims, wherein in the step of preparing the mould (12) tubes (6) and/or reinforcement bars (5) are provided within the mould (12), wherein the tubes (6) and/or reinforcement bars (5) and/or prestressing tendons are omitted at the side recess element (15).
 13. An apparatus (1) for manufacturing a concrete construction element (2) having hollow channels (4), comprising a mould (12) in which channel recess elements (13) are present for obtaining channels (4) in the construction element (2) to be made, **characterized in that** a side recess element (15) is located within the mould (12) at a predetermined location along and outside at least one of the channel recess elements (13) so as to create a hollow space (7) in a construction element (2) to be made at the side recess element (7), wherein the side recess element (15) has a minimum length which is smaller than the lengths of the hollow channels (4) of the resulting construction element (2) as seen in longitudinal direction thereof, and wherein the side recess element (15) has a minimum width which is smaller than the width of the resulting construction element (2) as seen in transverse direction thereof.
 14. An apparatus (1) according to claim 13, wherein the channel recess elements (13) are movable along the side recess element (15).





EUROPEAN SEARCH REPORT

Application Number
EP 11 00 5404

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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 December 2011	Examiner Rosborough, John
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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