

FLOW-TYPE CONCRETE CURING SYSTEM

Field of the Invention

5 The present invention relates to an apparatus for production of concrete members, in particular to a concrete curing system.

Background of the Invention

10 Traditionally, a procedure of producing a template for concrete members is separate from that of curing the template. The procedures are generally as follows. First, concrete is poured into a template with reinforcing steel bars tied. Then, after the concrete is set, the template is transferred through a hoisting tool to a curing region, where it is cured until the concrete member reaches its required strength. Last,
15 the final template is hoisted to another location for removal or the like. During this overhead hoisting procedure, the hoisting tool has to be mounted, dismantled and disposed manually, so that the concrete member may fall off the hoist tool, rendering a high risk. In addition, the hoisting operation should be performed by many operators together, causing the procedure time-consuming, tedious, and low efficient.

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 Moreover, current concrete members cannot be stacked too high in view of the labor operation. Therefore, the concrete members will be disposed in the curing region with a large area. Further, additional labor is necessary for shielding the occupied curing regionn with canvas. Accordingly, the situation of labor shortage will
25 become severer, causing the production cost higher and higher.

Summary of the Invention

 The technical problem to be solved by the present invention is to provide a
30 flow-type concrete curing system that can be operated automatically without a

hoisting tool.

In order to solve the above technical problem, the present invention proposes a flow-type concrete curing system, including a pre-fabricated member forming area for storing a template to be cast with concrete, and a curing area for curing the concrete. The flow-type concrete curing system further includes a track, and a lift carrier movable along the track for transferring the template. The pre-fabricated member forming area and the curing area are both located in a path of the track, with the pre-fabricated member forming area being located after the curing area. The curing area is provided with a closeable curing room, through which the track passes. The curing room has a rear end with a rear door, through which the lift carrier is accessible. The lift carrier includes a supporting frame, a bearing mechanism mounted on the supporting frame for bearing the template, and a lifting mechanism for driving the bearing mechanism to move up and down.

The track consists of two parallel guide rails, one at the right and one at the left. The pre-fabricated member forming area is arranged between the two parallel guide rails, and the pre-fabricated member forming area is provided with several vibrating tables therein.

The flow-type concrete curing system according to the present invention further includes a concrete discharging car, which is arranged after the lift carrier and movable along the track. The concrete discharging car has a discharging port, which is provided with a bracket for supporting a concrete vessel at each side thereof. The concrete discharging car is provided a second trolley at a bottom part of each side, and a third motor for driving the second trolley in movement. The second trolley is mounted on the guide rail.

The lift carrier further includes a first trolley arranged at a bottom of each side of the supporting frame, and a second motor for controlling movement of the first trolley.

The first trolley is mounted on the guide rail. The supporting frame includes two right and two left columns, beams for connecting two adjacent columns, and diagonal rods for connecting top parts of two columns arranged along a diagonal direction.

5 Before the curing room is a template removing area. The track extends forwardly out of the curing room to the template removing area. The curing room has a front end with a front door, through which the lift carrier is accessible. Two lift carriers are provided, one before another, and used to transfer the template forwardly to the curing room, and to the template removing area from the curing room, respectively.

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The track is provided, at a side thereof and along a direction from front to back, with a template cleaning and painting area, a rebar tying area, a template assembling area, and a template stacking area. The template stacking area is located at a side of the pre-fabricated member forming area, and at a side of and before the template removing area is a final pre-fabricated member stacking area.

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The curing room is provided therein with a heating device, at least one temperature probe, and at least one sensor for sensing the position of the template. The front door and the rear door are each configured as an electrical roll gate.

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The flow-type concrete curing system further includes a control device, which is in communication with the temperature probe, the sensor and electric actuators, and is used to control operations of the electric actuators.

25 The curing room has an openable or closable top, at the periphery of which a passageway and an outer guide rail are arranged. The passageway is connected with a stairway leading to ground.

The bearing mechanism includes a lifting frame, multiple bearing arms mounted on the lifting frame, and a hydraulic cylinder for controlling the bearing arms to

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extend or retreat.

The lifting mechanism comprises a winding reel, a first motor for controlling rotation of the winding reel, a pulling rope, and a fixed pulley mounted on the supporting frame, wherein the pulling rope has one end wound around the winding
 5 reel, and another end wound around the fixed pulley to connect with the lifting frame.

Compared with the prior arts, an automatic processing for templates from production to curing can be achieved according to the flow-type concrete curing
 10 system of the present invention,. The templates are produced with machine operations, and then transferred to the curing room through mechanical conveyor, with no hoisting means necessary. Therefore, the safety factor and the production efficiency are effectively enhanced, and the labor cost is significantly reduced..

15 **Brief Description of the Drawings**

Fig. 1 schematically shows the structure of a flow-type concrete curing system according to the present invention;

20 Fig. 2 schematically shows the structure of a concrete discharging car;

Fig. 3 shows the distribution of vibrating tables;

Fig. 4 schematically shows the structure of a lift carrier;

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Fig. 5 schematically shows the structure of a bearing mechanism;

Fig. 6 schematically shows the structures of a bearing arm and a hydraulic cylinder;

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Fig. 7 schematically shows the structure of a concrete vessel; and

Fig. 8 is a plan view showing the inner structure of a curing room.

5 **Detailed Description of the Embodiments**

The present invention will be described in further detail with reference to the most preferable embodiment as shown in the accompanying drawings.

10 As shown in Fig. 1, the flow-type concrete curing system according to the present invention includes: a track 4; a pre-fabricated member forming area 10, a curing area 20, and a template removing area 30, which are arranged along the track 4 from back to front; a concrete discharging car 1, which is movable along the track 4; and two lift carriers 3, a front one and a rear one. The pre-fabricated member forming
15 area 10 is used for disposing at least one template 7 to be cast with concrete. The concrete discharging car 1 can move forwardly along the track 4 to transfer concrete to a point above the template 7 arranged in the pre-fabricated member forming area 10, so that concrete can be poured in the template 7. The curing area 20 is provided with a closable curing room 5. The rear lift carrier 3 transfers the template 7 in the
20 pre-fabricated member forming area 10 forwardly along the track 4 to the curing room 5, so that the template 7 can be heated and cured there. After the concrete member is cured, the front lift carrier 3 transfers the template 7 in the curing room 5 forwardly along the track 4 to the template removing area 30, which is located before the curing room 5.

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As shown in Figs. 1 and 8, the track 4 consists of two parallel guide rails 41, one at the right and one at the left. The guide rail 41 can be that commonly used in railroad. The pre-fabricated member forming area 10 is arranged between said two guide rails 41, which extend to the template removing area 30 after passing through
30 the curing room 5.

As shown in Fig. 3, the pre-fabricated member forming area 10 is provided therein with several vibrating tables 2, on which the template 7 is disposed. With the vibration of the vibrating tables 2, the cast concrete can be distributed throughout the template 7 in a homogeneous and fast manner. In the present embodiment, there are five vibrating tables 2, which are respectively arranged at four corners and the center of the pre-fabricated member forming area 10. In addition, in order to prevent the displacement of the template 7 generated during the vibration, a blocking lip 21 extending upwardly is provided at outer edges of four corner vibrating tables 2, so that the outward displacement of the template 7 can be avoided.

The concrete discharging car 1 is arranged behind the lift carrier 3. As shown in Fig. 2, the concrete discharging car 1 is provided with a second trolley 13, which is arranged at each of the right and left sides of the bottom of the concrete discharging car 1, and a third motor 15 for controlling movement of the second trolley 13. The second trolley 13 is mounted on the guide rail 41 and driven by the third motor 15 in rotation, so that the concrete discharging car 1 will move forwardly or rearwardly along the guide rail 41. The concrete discharging car 1 further includes four vertical columns 16, two at the right and two at the left, which together support an upper platform 17. The platform 17 has a discharging port 11 at its middle portion. A bracket 12 is provided at each side of the discharging port 11 for supporting a concrete vessel 6. As shown in Fig. 7, the concrete vessel 6 is generally a concrete funnel, which has a horizontal square tube 61 at each side thereof. When the concrete vessel 6 is placed on the platform 17 of the concrete discharging car 1, the bracket 12 exactly supports a corresponding square tube 61 from bottom.

As shown in Fig. 4, the lift carrier 3 is used for transferring the template 7 along the track 4. The lift carrier 3 includes a supporting frame 31, a bearing mechanism 32 mounted on the supporting frame 31 for bearing the template, a lifting mechanism 33 for driving the bearing mechanism 32 to move up and down, first trolleys 34 mounted

at the right side and the left side of a bottom of the supporting frame 31, and a second motor 35 for controlling movement of the first trolleys 34.

The supporting frame 31 includes four columns 311 (two at right and two at left),
5 four upper and two lower beams 312 each connecting the top parts or the bottom parts of two adjacent columns 311, and two diagonal rods 313 each connecting the top parts of two columns 311 arranged along a diagonal direction. The first trolleys 34 are fixed at the bottoms of the lower beams 312 respectively, and placed on the guide rails 41 of the track 4. The second motor 35 drives the first trolleys 34 into rotation, so as to
10 move the supporting frame 31 forwardly or backwardly along the track 4.

As shown in Fig. 5, the bearing mechanism 32 comprises a lifting frame 321, multiple bearing arms 322 mounted on the lifting frame 321, and a hydraulic cylinder 323. The lifting frame 321 is a square frame structure consisting of two lateral rods
15 3211 (one arranged before the other) and two longitudinal rods 3212 (one at right and one at left), with two intermediate rods 3213 being fixed between said two longitudinal rods 3212. Each longitudinal rod 3212 includes two sub-rods, one above the other. A short post 326 is arranged at each corner of the square frame structure, so as to fix the lateral rod 3211 and the two sub-rods 3212 together. Each short post 326
20 is provided with two pulleys 325, one above the other. As shown in Fig. 4, the pulleys 325 abut against the columns 311 of the supporting frame 31, so that the lifting frame 321 can move along the column 311 along a vertical direction in a reliable manner. Four bearing arms 322 are mounted on said two longitudinal rods 3212, two arms on one rod. As shown in Fig. 6, each bearing arm 322 is provided with a hydraulic
25 cylinder 323 thereon, which can control the bearing arm 322 to extrude forwardly or retreat backwardly. A hydraulic pump 324 is mounted on the top of the two intermediate rods 3213, and connected with the hydraulic cylinder 323 of each bearing arm 322. The method of controlling the bearing arms 322 by means of the hydraulic pump 324 is known in the art, and thus would not be described here for the
30 sake of conciseness.

As shown in Fig. 4, the lifting mechanism 33 comprises a winding reel 331, a first motor 332 for controlling rotation of the winding reel 331, a pulling rope 333, and a fixed pulley 334 mounted on the supporting frame 31. The pulling rope 333 has one end wound around the winding reel 331, and another end wound around the fixed pulley 334 to connect with the lifting frame 321. Four sets of the lifting mechanism 33 are provided. Two of them are arranged at a right side and connected with the longitudinal rods 522 at the same side, while the other two are arranged at a left side and connected with the longitudinal rods 522 at the same side. The first motor 322 can control the rotation of the winding reel 331, and move the lifting frame 322 up or down through the pulling rope 333 and the fixed pulley 334. When the template 7 is transferred, the first motor 332 is activated to put down the lifting frame 321. In this case, the bearing arms 322 are retreated. When the bearing arms 322 are lower than the template 7, they are controlled by the hydraulic pump 324 to extend to a position under the template 7. In this case, the first motor 332 is activated to put up the lifting frame 321 and the template 7. When the template 7 is in position, the lifting frame 321 is put down, and the bearing arms 322 are retreated again. Accordingly, the template 7 can be transferred to its desirable position.

As shown in Figs. 1 and 8, in the present embodiment, the curing room 5 has a rectangular box-shaped structure, which has a height sufficient for accommodating five layers of templates 7, a width sufficient for accommodating one template 7, and a length sufficient for accommodating five templates 7. In this manner, a total of 25 templates 7, i.e., five rows and five layers of templates, can be cured in the curing room 5 simultaneously, thus significantly enhancing the production efficiency.

The curing room 5 is configured as a closable structure having a front end and a rear end, which are provided with a front door 52 and a rear door 51 respectively. The front door 52 and the rear door 51 are each configured as an electrical roll gate, so that the lift carrier 3 can pass through. In addition, the curing room 5 has an openable or

closable top, at the periphery of which a passageway 53 and an outer guard bar 54 are arranged. The passageway 53 is connected with a stairway leading to the ground. By means of which, operators can conveniently go to the top of the curing room 5 for operations, such as cleaning the concrete members placed in curing room 5 or the like.

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The inner floor of the curing room 5 is fixed thereon a right row and a left row of square template pedestals 57, which support the template 7 overhead for facilitating air circulation within the curing room 5 and homogeneous heating. The curing room 5 is further provided with a heating device, a plurality of temperature probes 55, and a plurality of sensors for sensing the positions of the templates. There are twenty
10 temperature probes 55, which are arranged in two layers. The twenty temperature probes 55 are further symmetrically arranged at two sides, each side containing ten temperature probes 55. The plurality of sensors is arranged corresponding to the layers of stacked templates 7. In the present embodiment, both sides of each layer of
15 the templates 7 are each provided with five pairs of sensors arranged along a vertical direction, with each pair of sensors corresponding to a respective layer of templates 7 in position. The heating device can adopt multiple heating means. In the present embodiment, a common vapor heating is used for curing. For this purpose, a vapor tube 56 extending along the lengthwise direction of the curing room 5 is arranged in
20 the middle portion of the floor of the curing room 5. The vapor tube 56, which is in communication with an outer vapor source, is provided with vapor output holes in an evenly spaced manner. Vapor can be released to both ends of the curing room 5 through an electromagnetic valve. If the temperature at either end of the curing room 5 is too low, vapor can be released to this end alone for thermal compensation. During
25 calculation, an averaged value of detecting results from ten temperature probes 55 is used. If any temperature probe 55 is in fault, the detecting result provided thereby will be automatically removed, and the averaged value of detecting results from the remaining normal temperature probes 55 is used for automatic curing.

30 To achieve automatic operation of the curing system and reduce labor, the

flow-type concrete curing system according to the present invention is further provided with a control device in communication with each temperature probe 55, each sensor, and each electrical actuator. The control device is a PLC, which can control actions of all electrical actuators collectively.

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As shown in Fig. 1, in order to further enhance the production efficiency, the track 4 is provided at a side with a template cleaning and painting area 40, a rebar tying area 50, a template assembling area 60, and a template stacking area 70. These areas are arranged along a direction from front to back, corresponding to the sequence of the process steps. In addition, the template stacking area 70 is arranged at a side of the pre-fabricated member forming area 10, so that it is convenient to transfer the template 7 to the template stacking area 70 for the production of a next pre-fabricated member. A final pre-fabricated member stacking area 80 is arranged before the template removing area 30 and at a side thereof. With such arrangement of areas, the distance and time necessary for transferring the template and the pre-fabricated member can be both significantly reduced.

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The process of the concrete curing system according to the present invention is substantially as follows, taking a pre-fabricated member of floor slab as an example.

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The stirred concrete is supplied to the concrete funnel 6 arranged on the concrete discharging car 1, and at the same time the template with tied rebars is transferred to the template stacking area 70.

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Then, the concrete discharging car 1 moves forwardly along the track 4 under the control of the control device to a position above the template 7 in the template stacking area 70, and retreats backwardly after the concrete is poured into template 7. The vibrating tables 2 are activated, so that the concrete in the template 7 can be evenly distributed throughout the template 7.

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Afterwards, under the control of the control device, the lift carrier 3 moves along the track 4 to the template 7, and the bearing mechanism 32 and the lifting mechanism 33 support the template 7. Then, the lift carrier 3 moves along the track 4 forwardly to the curing room 5. When the templates 7 are stacked, five templates 7 of the first layer are firstly stacked according to a sequence from front to back, then those of the second layer, and so on, finally those of the fifth layer, are stacked. During this procedure, after each layer of the templates 7 is placed, necessary operations such as concrete cleaning can be performed by an operator standing on the top passageway 53 of the curing room 5.

After the templates 7 are placed all over the curing room 5, the top, the front door 52 and the rear door 51 of the curing room 5 are closed, so that a close space is formed in the curing room 5. Then the heating device is activated and the electromagnetic valve is opened to release vapor from both ends of the curing room 5. Based on the temperature obtained by the temperature probes 55 arranged all over the curing room 5, the heating positions and the amount of released vapor can be adjusted through the electromagnetic valve, so that everywhere inside the curing room 5 can be kept at a temperature necessary for concrete curing.

After the concrete members have been cured, the front door 52 and the rear door 51 of the curing room 5 are opened, and the template 7 in the curing room 5 is transferred out by the front lift carrier 3 to the template removing area 30 for dismantling. The final pre-fabricated member is transferred to the final pre-fabricated member stacking area 80 which is in front of and at a side of the curing room 5. The template 7 removed is transferred to the template cleaning and painting area 40, which is near the template removing area 30, for cleaning and painting, and then to the rebar tying area 50, which is near the template cleaning and painting area 40 at rear side, for rebar tying. Subsequently, the template 7 is transferred to the template assembling area 60, which is near the rebar tying area 50 at rear side, for assembling embedding parts. Finally, the template 7 is transferred to the template stacking area 70, which is

near the template assembling area 60 at rear side, for stacking. When a next pre-fabricated member is to be produced, a completed template 7 stacked in the template stacking area 70 will be transferred out to the template stacking area 70 nearby.

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From the above it can be seen that according to the concrete curing system of the present invention, templates can be automatically transferred from production, curing and outer transportation. Therefore, the project working period can be shortened, and mechanization/automation can be achieved. In addition, labor cost is significantly

10 reduced, and the production efficiency is effectively enhanced.

The foregoing description is merely illustrative of preferred embodiments of the present invention, and is not intended to limit the present invention. Various changes and modifications may be made by those skilled in the art. Any modifications,

15 equivalent substitutions, improvements, and the like within the spirit and principles of the present invention are intended to be included within the scope of the present invention.

CLAIMS

1. A flow-type concrete curing system, including a pre-fabricated member forming area (10) for storing a template to be cast with concrete, and a curing area (20)
5 for curing the concrete,

characterized in that the flow-type concrete curing system further includes a track (4) and a lift carrier (3) movable along the track (4) for transferring the template, wherein the pre-fabricated member forming area (10) and the curing area (20) are both located in a path of the track (4), with the pre-fabricated member forming area
10 (10) being located after the curing area (20);

the curing area (20) is provided with a closeable curing room (5), through which the track (4) passes, wherein the curing room (5) has a rear end with a rear door (51) through which the lift carrier (3) is accessible;

the lift carrier (3) includes a supporting frame (31), a bearing mechanism (32)
15 mounted on the supporting frame (31) for bearing the template, and a lifting mechanism (33) for driving the bearing mechanism (32) to move up and down; and

the curing room (5) is provided therein with a heating device, at least one temperature probe, and at least one sensor for sensing the position of the template, wherein the front door (52) and the rear door (51) are each configured as an electrical
20 roll gate.

2. The flow-type concrete curing system according to claim 1, characterized in that the track (4) consists of two parallel guide rails (41), one at the right and one at the left, in between which the pre-fabricated member forming area (10) is arranged,
25 the pre-fabricated member forming area (10) being provided with several vibrating tables (2) therein.

3. The flow-type concrete curing system according to claim 2, characterized in that the flow-type concrete curing system further includes a concrete discharging car
30 (1), which is arranged after the lift carrier (3) and movable along the track (4), the

concrete discharging car (1) having a discharging port (11), which is provided with a bracket (12) for supporting a concrete vessel (6) at each side thereof; and

the concrete discharging car (1) is provided a second trolley (13) at a bottom part of each side, and a third motor (15) for driving the second trolley (13) in movement,
5 the second trolley (13) being mounted on the guide rail (41).

4. The flow-type concrete curing system according to claim 2, characterized in that the lift carrier (3) further includes a first trolley (34) arranged at a bottom of each side of the supporting frame (31), and a second motor (35) for controlling movement
10 of the first trolley (34), the first trolley (34) being mounted on the guide rail (41); and

the supporting frame (31) includes two right and two left columns (311), beams (312) for connecting two adjacent columns (311), and diagonal rods (313) for connecting top parts of two columns arranged along a diagonal direction.

15 5. The flow-type concrete curing system according to claim 1, characterized in that before the curing room (5) is a template removing area (30), wherein the track (4) extends forwardly out of the curing room (5) to the template removing area (30);

the curing room (5) has a front end with a front door (52) through which the lift carrier (3) is accessible; and

20 two lift carriers (3) are provided, one before another, and used to transfer the template forwardly to the curing room (5), and to the template removing area (30) from the curing room (5), respectively.

6. The flow-type concrete curing system according to claim 5, characterized in
25 that the track (4) is provided, at a side thereof and along a direction from front to back, with a template cleaning and painting area (40), a rebar tying area (50), a template assembling area (60), and a template stacking area (70), wherein the template stacking area (70) is located at a side of the pre-fabricated member forming area (10), and at a side of and before the template removing area (30) is a final pre-fabricated member
30 stacking area (80).

7. The flow-type concrete curing system according to claim 1, characterized in that the flow-type concrete curing system further includes a control device, which is in communication with the temperature probe, the sensor and electric actuators, and is
5 used to control operations of the electric actuators.

8. The flow-type concrete curing system according to claim 1, characterized in that the curing room (5) has an openable or closable top, at the periphery of which a passageway (53) and an outer guide rail (54) are arranged, the passageway (53) being
10 connected with a stairway leading to ground.

9. The flow-type concrete curing system according to any one of claims 1 to 6, characterized in that the bearing mechanism (32) includes a lifting frame (321), multiple bearing arms (322) mounted on the lifting frame (321), and a hydraulic
15 cylinder (323) for controlling the bearing arms (322) to extend or retreat.

10. The flow-type concrete curing system according to claim 9, characterized in that the lifting mechanism (33) comprises a winding reel (331), a first motor (332) for controlling rotation of the winding reel (331), a pulling rope (333), and a fixed pulley
20 (334) mounted on the supporting frame (31), wherein the pulling rope (333) has one end wound around the winding reel (331), and another end wound around the fixed pulley (334) to connect with the lifting frame (321).