METHOD AND AN APPARATUS FOR THE CONTINUOUS MANUFACTURE OF LIGHT-WEIGHT CONCRETE IN BLOCK FORM

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In previously known methods of producing building-stones of so-called light-weight concrete moulds of iron-plate are generally used, said moulds being filled with a suitable means which is allowed to expand and set. The porous blocks obtained in this way are then divided up into smaller pieces forming blocks or similar articles. The necessary number of moulds occupied is considerable in consequence of the setting time and causes a substantial part of the costs of procuring and of construction. Furthermore every mould has to be transported over great distances to different places of work for molding, sawing, hardening, etc. This involves a great number of working hours, thus making the product more expensive.

The present invention refers to a device, by means of which the production of blocks and beams may be carried out continuously and substantially completely automatically. The device according to the invention will be described in the following specification with reference to the enclosed drawings which show different embodiments of the invention without limiting, however, the invention to the shown embodiments.

Fig. 1 shows a side elevation of a device according to the invention, and Fig. 2 shows a plan view of the same device. Fig. 3 shows a vertical section of a feeding- and mixing device for light-weight-concrete-mass. Fig. 4 shows a plan view of the device according to Fig. 3. Fig. 5 shows a side elevation of a modified embodiment of a conveyor type mould. Fig. 6 shows a plan view of the device according to Fig. 5. Fig. 7 shows an embodiment of a feeding-out device for ready-cut products from the movable mould. Fig. 8 shows an elevation of a partition element adapted to be introduced in a light-weight concrete strip progressing in the movable mould and to divide up the strip longitudinally. Fig. 9 shows a section along the line IX—IX in Fig. 8. Fig. 10 shows a larger scale the lower part of the section according to Fig. 9. Fig. 11 shows a side elevation of a device adapted to automatically introduce the partition-element into the movable mould. Fig. 12 shows a device for cutting the light-weight concrete strip perpendicularly to its longitudinal direction.

In the device according to Fig. 1 the ingredients of the light-weight concrete mass are mixed in a mixer 1. The highly liquid mass is fed through a pipe 2 into a volume controller 3, the volume of which is adjustable by means of a tube 4 which may be raised or lowered and serves as a feed-back tube to the mixer 1. From the controller the mixture passes through an operating valve 4 to a fine-mixer 5 upon simultaneous adding of an expanding agent for example pulverous aluminium. In the fine-mixer 5 an intensive stirring is obtained by means of stirring members. The fine-mixers 5 are located above a funnel-shaped container 8 and are emptied alternately into said container in such a manner, that a mixture of light-weight concrete flows continuously into the conveyor type mould.

Said mould consists of a substantially horizontal endless conveyor belt 21 of steel forming together with two endless shorter side-belts 22 an upward open channel for the concrete mass, the bottom and the side-walls of said channel being supported by horizontal rollers 40 (Fig. 1) and vertical rollers 41 (Fig. 2) respectively. Said rollers have to be placed very near to each other at least along that part of the conveyor type mould in which the mass had not yet had time to solidify. If necessary the rollers may be replaced by a sliding plane consisting for example of boards. At the backside the channel is closed by an adjustable gate 45 having a resilient packing of rubber. The mass coming from the mixer 5 is highly liquid when coming onto the conveyor-belt 21 but it "expands" and sets rapidly and increases in level when advancing by means of the conveyor belt 21 and the side-belts 22 which have the same velocity. By increasing or decreasing the introduced quantity of mass relatively to the velocity of the conveyor belt it is possible to regulate the thickness of the concrete strip produced.

The length of the channel and the velocity of the conveyor belt and of the side-belts are adjusted in such a manner that the expanded and set string of light-weight concrete obtains a suitable thickness and solidity before coming to the cutting devices. In order to accelerate said setting process a funnel-shaped heating device 23 is arranged around the channel when necessary.

The concrete strip is cut longitudinally by means of wires 25 stretched on a frame 24 which is caused to reciprocate in a direction parallel to the longitudinal axes of the wires. The device used for this purpose is well-known per se and is not shown in the drawing.

For cutting the concrete strip perpendicularly to its longitudinal direction a mechanism is used which is shown in Fig. 12. Owing to the longitudinal movement of the strip the cutting wire 28 must have the same velocity during the cutting operation as the concrete strip. The cutting wire 28 is fixed between rods 29 which horizontally are guided by rods 30 and in the cutting direction are driven by a crank 31 operated by the driving roller 34 of the conveyor belt by means of chains 32, 33.

In order to enable the cutting wire 28 to exactly follow the movement of the concrete strip, said rod 30 obtains a reciprocating movement by means of a cam 35.

The conveyor band 21 turns around the driving roller 34 and the concrete strip continues its movement over a small endless roller mat 36 (Fig. 1) to a transportable conveyor belt 37 which carries the ready-cut building-stones into an autoclave 38.

A plurality of feeding bands 39 are lying below the conveyor-band 37, said feeding bands 39 being connected with each other to a long band which is coiled so as to form a roll 42. The feeding bands are introduced between the upper part of the conveyor belt and the underside of the concrete blocks with velocity equal to the advancing velocity of the concrete blocks. In this way the blocks will be transferred from the roller-mat 36 to a feeding band 39 without any friction. When a feeding band is fully loaded it will be disengaged from the succeeding band, the conveyor will be moved aside and a new conveyor moved to its place in order to receive the next feeding band.

The fully loaded conveyor is moved to one of the autoclaves 38 and the feeding band 39 together with the blocks lying on it is moved from the conveyor into the autoclave on rollers 44. The conveyor 37 may be raised or lowered on its support so as to be able to introduce the feeding bands 39 into partitions lying on different levels in the autoclave.

Figs. 3 and 4 show an arrangement of the mixing device for the light-weight concrete mass. The different ingredients such as slate-powder, sand, lime are introduced into a balance-pocket 60 by means of a conveyor screw 61 which roughly mixes the substances and presses
the same from the balance-pocket 60 through a tube 62 to one of a number of peripheral openings in a stationary horizontal plate or bar 63 positioned below the balance-pocket 60 and arranged obliquely to the same for introducing the rough mixture into a multiple-mixer. Said multiple mixers comprises six small mixers 65 adapted to rotate around a vertical inner shaft 64, located below the bar 63 within the periphery of the same and provided with peripheral, relatively long inlet openings 66 at the upper part of the mixer for cooperation with the openings in the bar. Through the openings the different ingredients are admitted at definite intervals during the rotation of the mixers around the inner shaft 64. On the side of the balance-pocket 60 a water container 67 is fixed stationarily. It has an outlet tube 68 to said bar 63 and to an opening in the same in such a manner that when an opening 66 of a mixer is coming to said opening of the bar during the rotation of the mixers around the inner shaft 64, a definite quantity of water is admitted into the mixer 65 in question. Addition of an expanding agent for example pulverous aluminium is carried out similarly from a funnel 70 provided with a conveyor 86. The expanding agent is added when the mixer in question is near to the point where its contents are emptied into the conveyor type mould. The development of the gas begins immediately after the expanding agent has been added and the expansion must occur substantially in the mould, the mixers 65 having to be emptied as soon as possible after the expanding agent has been added.

Every mixer 65 is provided with a stirring member 69 having a vertical shaft 70 supported in a gear-casing 71 which is common for all the mixers 65. In said casing 71 a gear 73 fixed on the lower end of the inner shaft 64 engages another gear 73 fixed on the end part of each of said mixers within the casing 71. The stirring members 69 may consequently be driven by the inner shaft 64. Simultaneously with said stirring members 69, the mixers 65 fixed on the casing will rotate as the casing 71 is fixed on the lower part of a tubular shaft 74 which surrounds the inner shaft 64 and at its upper end is provided with a chain-gear 75 in order to bring the tubular shaft 74 and hereby the mixers to rotate around the inner shaft 64. Also said inner shaft 64 may be brought to rotate by means of a driving chain at its upper end 76. The whole multiple-mixer is suspended on a frame 77 having a hub 78 in which the tubular shaft 74 is rotatably supported.

Each mixer 65 is at the bottom provided with a clamp-valve 78 which may be opened downward and serves for emptying the mixer 65. Said valve is released in a definite position of the mixer 65, by a pressing rod 79 which is affected by springs 80 and which in other positions of the mixer maintains said clamp-valve 78 pressed tight against the lower part of the mixer. Each mixer 65 comes during its rotation into a position above the conveyor 21 which together with its sidebells 22 is located below the multiple-mixer and laterally to the same in such a manner that the conveyor channel 21, 22 receives the mixture from every mixer 65 just when the clamp-valve is opened above the conveyor 21, depending on the fact that in this position the pressing bar 79 is contracted or has an opening within the clamp-valve 78 which consequently owing to its own weight may pivot around a hinge-like bearing. When the mixer continues to rotate, the pressing bar 79 engages again the clamp-valve 78, and brings it automatically into closed position.

In Fig. 4 is shown the cycle of operation of each mixer during a turn around the inner shaft 64. When the opening 66 of each mixer 65 comes to the outlet of the vertical sanitary tubing 63, a definite quantity of material is admitted into the mixer 65 through the opening in the stationary rod 63. When the same mixer 65 arrives to the balance-pocket 60 a definite well-balanced quantity of slate-powder or sand or similar is fed into the mixer 65. Simultaneously an intense mixing of the substances occurs in the mixer 65 owing to the rotation of the stirring member 69 and the mixer 65 relatively to each other. Finally when the mixer passes the outlet of the funnel 95 an expanding agent is added, e.g. pulvorous aluminium. Simultaneously the mixer is rotating above the conveyor 21, the clamp-valve 78 is opened automatically and the content of the mixer is flowing into the conveyor type mould. After the mixer 65 has been emptied, it is washed with water which is furnished through the pipe 62. After further rotation of the mixer the clamp-valve 78 is closed automatically and thereafter the same operation is repeated as during the preceding turn. In the multiple-mixer at least one of the mixers is consequently always in the state of emptying while the following mixer contains a ready mixed light-weight concrete mass ready for an immediately following emptying. As pulverous aluminium or some other expanding agent is introduced into a mixer according to the invention immediately before the mixer is emptied there is no sufficient time for a substantial expanding of the concrete mass in the mixers, the mass being easily removed from the mixer so that the expansion occurs in the channel 21, 22.

Naturally the mixing device also may consist of only two mixers, one of which is in the state of emptying simultaneously with the mixing of a new charge in the other one. Furthermore more than six mixers 65 may be used if a high production of Ready-mix is desired.

Figs. 5 and 6 show an embodiment of the conveyor type mould in the device according to the invention. By 21 is indicated the horizontal conveyor, on both longitudinal side-edges of which vertical endless side-belts 22 are located. The horizontal conveyor-belt 21 is supported by supporting rollers 40 and possibly also by a support 44 of iron or wood (Fig. 5) on which the belt 22 is sliding. The side-belts 22 are pressed against the bottom-belt 21 by means of rollers 45z which are maintained against the upper edges of the side-belts by weights 43. By said arrangement a leakage of the concrete mass may be substantially eliminated. Furthermore tensioning members 46 are arranged for regulating the tension of the vertical side-belt 22. Other tensioning members 47 are arranged for the conveyor belt 21, and cooperating with suitable wires and counterweights not shown in the drawing. The belt 21 is driven by a driving device 48 with a variable speed.

Fig. 7 shows an embodiment of a discharging device for ready-cut concrete-blocks. The concrete strip 49 which in this case is supposed to be cut perpendicularly to its longitudinal direction is moving forward from the conveyor belt 21 over an endless passing belt 50 which forms a bridge between said conveyor belt 21 and a roller 53. The belt 50 is supported by closely located supporting rollers 51. Also said passing belt 50 is provided with a stretching roller 52. Feeding bands 39 of iron plate are arranged in a pile 58, a feeding drum 53 being adapted to move said feeding bands 39 from the pile to the under-side of the concrete strip, said drum 53 co-operating with supporting rollers 54 arranged in front of the same for enabling the passage of the feeding bands 39.

The concrete strip 49 moves from the passing belt 50 to a sliding plane 55 lying on supporting rollers 54. Said passing belt 50 moves over relatively small supporting end-rollers 56 located at the opposite upper parts of the drum 53 and of a driving drum 57 for the conveyor belt 21 respectively. The feeding drum 53 is driven by a chain 59 from the driving drum 57 of the conveyor belt 21 in each a manner that the peripheral velocity of both drums will be the same. Between the drum 53 and the adjacent end of the sliding plane 55 and above the feeding drum 53, a cutting member 58 is located for cutting longitudinally the concrete strip 49 before it arrives to the sliding plane 55. When the concrete strip 49
during its progression comes to the end of the conveyor belt 21, it is sliding over to the passing belt 50 which suitably consists of a flexible rubber-belt easily ducible around said small supporting end-rollers 56. During the progression of the conveyor belt 49 on the passing belt the last mentioned is driven by the friction with the concrete strip 49 during its movement. The transversal cutting of the strip has already been carried out on the last section of the conveyor belt 21 and the longitudinal cutting is carried out by means of said cutting member 98 by using saw wires in a manner per se known. In the device shown in the drawings the cutting member 58 comprises wires having a reciprocating motion in a direction parallel to their longitudinal axes. The wires form an angle of about 60° to the concrete strip in the vertical plane. If necessary the wires may be arranged vertically i.e. perpendicularly to the concrete string. The blocks produced are transported to one of the feeding bands 39 moving with exactly the same speed as the conveyor belt 21 with a position above the sliding plane 55 which lies immobile until the whole feeding band 39 has arrived at said position. The feeding band is subsequently detached and removed by the rollers 54.

When it is desirable to divide the concrete strip into blocks when discharging the mass on the conveyor belt, separate partitions are used and introduced into the conveyor type mould at suitable intervals. Figs. 8, 9 and 10 show an embodiment of such partitions which have box-shape and consist of side-walls 81 of steel plate and a frame 82 of strong section steel, packing washers 83 of rubber being located between each side wall 81 and the frame 82, the walls 81 being fixed by means of screws on the frame 82. The partitions have a length somewhat exceeding the distance between the side-belts 22 in such a manner that when introducing a partition into the conveyor type mould, the protruding parts of the packing washers 83 will be compressed, thereby forming a good packing so that the partitions are maintained in place by friction with the bottom and side belts of the conveyor type mould.

Fig. 11 shows a side elevation of a device for introducing automatically the partitions into the conveyor type mould at its outer end before it comes to the mixers 65. A piston rod 84 is driven by compressed air or pressure oil from a press plunger 85. The free end of the piston rod is provided with a holder for removably suspending a partition 81, 82. Upon forward motion of the piston rod the partition is introduced into the conveyor mould perpendicularly to the belts 21 and 22. Upon retraction of the piston rod the said holder 85 is withdrawn so that the partition 81 and 82 is left in position which follows the mould on its movement. Above the conveyor type mould an operating valve 87 is located and connected in the inlet pipe of the pressure fluid to the piston casing 85. When the upper edge of the partition 81, 82 comes into contact with the operating valve 87 an impulse is sent to the compression cylinder 85 with the result that a new partition 81, 82 suspended on the end of the piston rod 84 is pushed automatically into the channel 21, 22. The operating valve 87 is supported on a graduated rod 90 which is adjustably fixed in a bearing 88 in such a manner that the operating valve 87 may be adjusted to every desirable distance between the partitions 81, 82 introduced successively into the mould 21, 22.

Also armoured products as plates and beams may be produced by means of the device according to the invention. The armouring which e.g. may consist of a framework of reinforcing put on the bottom belt 22 of the mould at the inlet end of the same and it follows the mould on its movement. The concrete mass expands around the armouring and surrounds it completely. The plates or beams may be separated from each other by means of individual partitions as described in the foregoing the concrete strip may be cut in a usual manner after setting.

The device according to the invention may be used also for a half continuous production of light-weight concrete. In this case the trough formed by the bottom belt and the side belts is filled by concrete mass to a suitable level, the mass being allowed to expand while the belts are kept immobile whereupon the belts are started and the strip obtained is sawn into blocks as described above.

What we claim is:

1. Apparatus for the continuous manufacture of blocks from light weight concrete which is expandable during setting comprising a moving open-trench conveyor type mould having an input end and a discharge end, said mould consisting of a horizontal endless conveyor forming the bottom of the mould, vertical endless conveyors above and at either side of the horizontal conveyor forming the side walls of the mould, said horizontal and vertical conveyors having the same speed of travel, and means for pressing said vertical conveyors downwardly upon said horizontal conveyor to provide a fluid-tight seal therebetween a stationary gate member transversely arranged within said mould at the input end of said gate member being in engagement with said vertical and horizontal endless conveyors to define an end wall of said mould; means for preparing and continuously delivering a constant weight per unit time of the concrete in its fluid state into said moulding mould, adjacent said gate member, said concrete freely expanding vertically in the mould during setting; means for cutting the concrete in its plastic state in the mould into blocks; an endless belt arranged to receive the light weight concrete blocks from the discharge end of said conveyor type mould, said endless belt having the same speed as said conveyor mould; means for inserting a flexible sheet between the upper surface of the endless belt and the light weight concrete blocks; and means for transporting said sheet and said blocks situated thereon to a concrete hardening chamber.

2. Apparatus as defined in claim 1 and further including an endless passing belt intermediate the discharge end of said conveyor mould and said horizontal endless conveyor, said passing belt having the same speed of travel as said conveyor type mould; the upper surfaces of the mould horizontal conveyor, the passing belt and the endless conveyor being substantially coplanar, the front and rear pulleys of said passing belt having a diameter considerably smaller than the diameter of the pulley at the discharge end of the mould horizontal conveyor.

3. Apparatus for the continuous manufacture of blocks from light weight concrete comprising a conveyor type mould having bottom and side walls, said mould having a charging end and a discharging end, means adjacent the charging end of said mould for periodically inserting rectangular partition walls transversely in said mould, the peripheral edges of said partition walls being resilient and in contiguous frictional engagement with the mould bottom and side walls so that said partition walls travel longitudinally with the mould, said partition wall inserting means including actuating means intermediate and spaced from said inserting means and the discharge end of the conveyor and operable by a previous one of said transverse walls during transport of the same with said conveyor mould, and means for preparing concrete and delivering the same in the fluid state into said mould, whereby said partition walls divide the concrete into separate portions.

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