

DESCRIPTION  
CONCRETE MIXER AND READY-MIX CONCRETE PRODUCTION PLANT  
USING THE SAME

Technical Field

[0001]

The present invention relates to a concrete mixer and a ready-mix concrete production plant using the same.

Background Art

[0002]

Heretofore, ready-mix concrete has been produced in a batcher plant, which is a ready-mix concrete production plant. In a batcher plant, a concrete mixer is used (refer, for example, to Patent Literature 1). A concrete mixer blends various materials, such as gravel as a coarse aggregate, sand as a fine aggregate, cement, water, and a chemical admixture.

[0003]

Figure 11 is a view showing the internal structure of a conventional concrete mixer. A concrete mixer 50 includes a mixer main body 51, as well as 2 kneading axes 52, 53. The kneading axes 52, 53 are installed rotatably in the mixer main body 51. The kneading axes 52, 53 are provided with a plurality of paddles 54, which blend such various materials described above. Each paddle 54 is constituted with an arm 55 and a blade 56. The arm 55 is connected with either of kneading axes 52, 53. The blade 56 is placed at a tip of the arm 55.

[0004]

A plurality of blades 56 are placed in a row. The blades 56 in a row are aligned in a spiral and belt form circumferentially around either of kneading axes 52, 53. Outside the mixer main body 51 motors 57, 58 are mounted, which rotate the

kneading axes 52, 53.

[0005]

In the concrete mixer 50, the respective materials describe above are charged into the mixer main body 51. In the concrete mixer 50 the kneading axes 52, 53 are rotated in the circumferential direction by the motors 57, 58, so that the respective materials are mixed together by the blades 56. In the concrete mixer 50, the blades 56 are aligned in a row and a band form. Therefore, a mixture is moved by the blades 56 smoothly and in a relatively short time in the mixer main body 51.

[0006]

Ordinarily, right after initiation of blending the viscosity of materials is low, which increases after an elapse of certain blending time after the start of mixing of all the materials. In the concrete mixer 50, a highly viscous mixture is not lifted by the blades 56 aligned in a band form, rather the highly viscous mixture is moved mainly along the flanks of the blades 56. In the conventional concrete mixer 50, there has been a drawback that a shear effect on a highly viscous mixture is small.

[0007]

Further, when the materials are transported along the flanks of the blades 56, the materials (refer to Symbol M) are apt to roll over the bottom of the mixer main body 51 and along the flanks of the blades 56 as shown in Figure 12. When the rolling distance of the materials increases, the material volume expands and as the result so called balled lumps are generated. Such balled lumps cause deterioration of the quality of ready-mix concrete. Therefore, rolling of materials should be suppressed as much as possible in the concrete mixer 50.

Prior Art Literatures

[Patent Literature]

[0008]

[Patent Literature 1] JP 2008-212888 A

[Summary of Invention]

[Problem to be solved by the invention]

[0009]

The present invention was worked out under such circumstances. An object of the present invention is to provide a concrete mixer which can carry out blending efficiently by enhancing a mixing and shearing effect on a mixture. Another object of the present invention is to provide a ready-mix concrete production plant using the concrete mixer.

[Solution to Problem]

[0010]

A concrete mixer provided according to a first aspect of the present invention comprises a mixer main body which can accommodate a plurality of materials to be used as source materials for ready-mix concrete; a kneading axis placed rotatably inside the mixer main body; and a plurality of mixing paddles for mixing the plurality of materials; wherein the mixing paddle comprises an arm connected with the kneading axis, and a first blade placed at a tip of the arm; wherein the first blades of the plurality of mixing paddles are placed forming a spiral row circumferentially around the kneading axis; and there is a trough between adjacent first blades among the first blades placed in a row, such that the width of a gap between the first blades constituting the trough narrows with the distance from the kneading axis.

[0011]

In a concrete mixer according to the present invention the first blades are formed substantially arcuate, and the trough is preferably formed by butting each other end faces of the first blades placed in a row.

[0012]

In a concrete mixer according to the present invention, at an axially

symmetric position of any one of the plurality of mixing paddles with respect to the kneading axis, it is preferred to arrange a first shearing paddle for shearing a kneaded mixture of the plurality of materials, which first shearing paddle comprises a substantially securiform second blade.

[0013]

In a concrete mixer according to the present invention, a first transporting paddle, which has an arm connected with the kneading axis, and a substantially planar third blade provided along the flank of the arm, and is for transporting the mixture outside a rotation range of the third blade, is preferably provided at an axially symmetric position of the mixing paddle placed at a side in the direction of the kneading axis of the mixer main body among the plurality of mixing paddles with respect to the kneading axis.

[0014]

A concrete mixer according to the present invention is preferably provided additionally with a mixing paddle placed on the kneading axis, as well as a second shearing paddle, which has a substantially securiform second blade, and is for shearing the mixture of a kneaded mixture of the plurality of materials, at an axially symmetric position of the mixing paddle with respect to the kneading axis.

[0015]

A concrete mixer according to the present invention is preferably provided with a second transporting paddle, which comprises an arm connected with the kneading axis, and a substantially planar third blade placed along a flank of the arm, and is placed on the kneading axis for transporting the mixture outside a rotation range of the third blade; and with a third transporting paddle, which is constituted similarly as the second transporting paddle, and is placed at an axially symmetric position of the second transporting paddle with respect to the kneading axis for transporting the mixture outside a rotation range of the third blade.

[0016]

In a concrete mixer according to the present invention, preferably two of the kneading axes are juxtaposed in the mixer main body, and on one of the kneading axes the plurality of mixing paddles, the second shearing paddle, and the second transporting paddle are provided side by side in the mentioned order from a side in the direction of the kneading axis of the mixer main body, while on the other kneading axis the second transporting paddle, the second shearing paddle, and the plurality of mixing paddles are provided side by side in the mentioned order from the side of the mixer main body.

[0017]

In a concrete mixer according to the present invention preferably at a position symmetric to one of the kneading axes provided with the first transporting paddle, the second transporting paddle is placed on the other kneading axis, wherein, the first transporting paddle placed on the former kneading axis, and the second transporting paddle placed on the latter kneading axis rotate in the opposite direction around the kneading axes maintaining a phase difference of 90°.

[0018]

A ready-mix concrete production plant according to the second aspect of the present invention is provided with a concrete mixer to be provided according to the first aspect of the present invention.

[Advantageous Effects of Invention]

[0019]

According to the present invention, a plurality of first blades are aligned in a row in a spiral form circumferentially around the kneading axis. There is a trough between adjacent first blades among a plurality of the first blades. A space in the vicinity of the trough flows irregularly when a mixing paddle is rotated. The material moves also irregularly corresponding to the space. Therefore a concrete

mixer according to the present invention can enhance a mixing and shearing effect on a blended material so that a mixture can be blended efficiently.

#### Brief Description of Drawings

[0020]

Figure 1 is a schematic diagram of the structure of a ready-mix concrete production plant using a concrete mixer according to the present invention.

Figure 2 is a front view of a concrete mixer.

Figure 3 is a side view of a concrete mixer.

Figure 4 is a top view of a concrete mixer.

Figure 5 is a perspective view showing the internal structure of a concrete mixer.

Figure 6 is a view in the axial direction of a kneading axis showing first to third mixing paddles.

Figure 7 is diagrams showing rotational states of the first to third mixing paddles.

Figure 8 is a schematic diagram superimposing the respective states of the first to third mixing paddles.

Figure 9 is a diagram showing the actions of the first to third mixing paddles.

Figure 10 is a diagram showing the actions of first to third transporting paddles.

Figure 11 is a view showing the internal structure of a conventional concrete mixer.

Figure 12 is a diagram explaining the actions of a conventional concrete mixer.

Mode for carrying out the invention]

[0021]

An embodiment of the present invention will be described more specifically below referring to drawings.

[0022]

Figure 1 is a schematic diagram of the structure of a ready-mix concrete production plant (batcher plant). A batcher plant 1 shown in Figure 1 utilizes a concrete mixer according to the present invention. A batcher plant 1 is a plant for producing ready-mix concrete. The components of ready-mix concrete include gravel (coarse aggregate), sand (fine aggregate), cement, water and chemical admixture (hereinafter collectively referred to as "mixture"). The batcher plant 1 is provided with a belt conveyor 2, which transports an aggregate from a storage silo (not illustrated) storing an aggregate. The aggregate transported by the belt conveyor 2 is distributed by a turn chute 3 into a plurality of storage bins 4.

[0023]

A plurality of measuring hoppers 5 are installed below the plurality of storage bins 4. The measuring hopper 5 measures respective materials discharged from the storage bins 4. In the batcher plant 1 a water storage vessel (not illustrated) is installed, which stores water. Below the water storage vessel a water measuring hopper 6 is installed, which measures water.

[0024]

Below the measuring hoppers 5, a source material chute 7 is installed, which collects each source material discharged from each measuring hopper 5. Downstream of the source material chute 7 a concrete mixer 8 is installed. All the materials are discharged from the source material chute 7. Water is sent from the water measuring hopper 6. The concrete mixer 8 blends each material and water together. Below the concrete mixer 8, a concrete hopper 9 is installed, from which ready-mix concrete prepared by blending in the concrete mixer 8 is charged into an agitator truck (concrete mixer truck, not illustrated).

[0025]

Figure 2 is a front view of the concrete mixer 8. Figure 3 is a side view of the concrete mixer 8. Figure 4 is a top view of the concrete mixer 8. Figure 5 is a perspective view showing the internal structure of the concrete mixer 8. In this regard, in Figure 4 a ceiling part of a mixer main body 10 (described below) is removed.

[0026]

The concrete mixer 8 blends gravel, sand, cement, water, a chemical admixture, *etc.* The concrete mixer 8 includes a mixer main body 10 as shown in Figure 2 to Figure 4. The mixer main body 10 may have a desired size. Inside the mixer main body 10, a first kneading axis 11 and a second kneading axis 12 are rotatably provided side by side. The first kneading axis 11 and the second kneading axis 12 are respectively formed substantially cylindrical extending in a predetermined direction. The first kneading axis 11 and the second kneading axis 12 are rotated in mutually opposing directions. For example, the first kneading axis 11 is rotated clockwise (refer to arrow C1 in Figure 5), and the second kneading axis 12 is rotated counterclockwise (refer to arrow C2 in Figure 5).

[0027]

The first kneading axis 11 is driven to rotate by a first drive motor 13 and a first reduction gear 15. The first drive motor 13 and the first reduction gear 15 are placed at the front part of the mixer main body 10. Meanwhile, the second kneading axis 12 is driven to rotate by a second drive motor 14 and a second reduction gear 16. The first drive motor 13 is a drive source for rotating the first kneading axis 11, and the second drive motor 14 is a drive source for rotating the second kneading axis 12. The first reduction gear 15 modifies a driving force of the first drive motor 13, and the second reduction gear 16 modifies a driving force of the second drive motor 14.

[0028]

A V pulley (not illustrated) is provided on an output axis of the first drive motor 13 and on an input axis of the first reduction gear 15. A V pulley (not illustrated) is provided on an output axis of the second drive motor 14 and on an input axis of the second reduction gear 16. A V belt (not illustrated) is spanned over each V pulley. The output axis of the first reduction gear 15 is connected with the first kneading axis 11, while the output axis of the second reduction gear 16 is connected with the second kneading axis 12. The V pulleys and the V belts are covered by a first cover 17 or a second cover 18.

[0029]

According to the constitution a driving force of the first drive motor 13 is transmitted to the first reduction gear 15, and a driving force of the second drive motor 14 is transmitted to the second reduction gear 16. An output of the first reduction gear 15 is transmitted to the first kneading axis 11, and an output of the second reduction gear 16 is transmitted to the second kneading axis 12. By the above, the first kneading axis 11 and the second kneading axis 12 are driven to rotate.

[0030]

The sign 19 in Figure 3 shows a feeding port of water sent from the water measuring hopper 6. The sign 20 shows an openable inspection window. Further, counter pieces (not illustrated) are mounted on the kneading axes 11, 12 respectively inside the mixer main body 10. Hereinbelow, the expression of kneading axes 11, 12 includes the counter pieces.

[0031]

The first kneading axis 11 is provided with a first paddle module 21, a second paddle module 22, and a third paddle module 23 respectively, and the second kneading axis 12 is also provided with a first paddle module 21, a second

paddle module 22, and a third paddle module 23 respectively. The first paddle module 21, the second paddle module 22, and the third paddle module 23 are provided with paddles different in a shape from each other. In this regard, a paddle module means a paddle group consisted with a plurality of paddles (details described below).

[0032]

The first paddle module 21 mixes and shears a mixture efficiently. The first paddle module 21 suppresses "rolling of material", and improves "pass of material". In this regard, "rolling of material" means that a material rolls over the bottom of the mixer main body 10, and "pass of material" means that a material passes through between paddles (or arms).

[0033]

The first paddle module 21 is constituted with a first mixing paddle 24, a second mixing paddle 25, and a third mixing paddle 26, as well as a first shearing paddle 27, and a first transporting paddle 28. The first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 mainly mix and shear a mixture. The first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 are respectively constituted with an arm 29 and a blade (first blade) 30. The arms 29 are respectively connected with the first kneading axis 11. The blade 30 is placed at a tip of the arm 29.

[0034]

The arms 29 are placed on the first kneading axis 11 at predetermined intervals in the axial direction. As shown in Figure 6, the arms 29 extend respectively in the radial direction at an angle of substantially 90° with respect to the axial direction of the first kneading axis 11. In this connection, in Figure 6 only the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 are shown and other paddles are omitted.

[0035]

The blade 30 is constituted with a substantially arcuate-shaped flat plate. More precisely, the blade 30 is constituted with 2 individual blades. The blade 30 is configured such that wider end faces of the respective individual blades are butted together. The blade 30 is formed relatively long in the width direction compared to a conventional constitution, so that the number of arms 29 for fixing the blades 30 can be decreased. In this regard, the 2 individual blades may be formed in one piece.

[0036]

The first paddle module 21 is as shown in Figure 4 provided with 3 mixing paddles of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26, wherein the first mixing paddle 24 is placed near the internal end surface of the mixer main body 10 on the side of the first drive motor 13. In the first paddle module 21 the second mixing paddle 25, and the third mixing paddle 26 are placed in this order toward the left in Figure 4.

[0037]

A plurality of blades 30 of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 are placed in a spiral form circumferentially around the first kneading axis 11 butting the narrow ends each other in a row. The circumferences of the plurality of blades 30 are formed as shown in Figure 6 circular when seen along the axial direction of the first kneading axis 11. The plurality of blades 30 have a trough between adjacent blades 30, which gap between the blades 30 narrows with the distance from the first kneading axis 11 (refer to the sign Q in Figure 6). In this connection, the trough in Figure 6 forms an almost right angle, however the same may also form an acute angle or an obtuse angle.

[0038]

The first shearing paddle 27 mainly shears a mixture. The first shearing paddle 27 is placed axially symmetric to the second mixing paddle 25 with respect to the first kneading axis 11. The first shearing paddle 27 is constituted with an arm 29 and a blade (the second blade) 31. The arm 29 is connected with the first kneading axis 11. The blade 31 is placed at a tip of the arm 29. The blade 31 is formed substantially securiform in a side view. A tip of the substantially securiform blade 31 points to the rotational direction of the first kneading axis 11. The side area of the blade 31 is slightly smaller than those of the blades 30 of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26.

[0039]

The first transporting paddle 28 pushes out a mixture out of a rotation range of a blade (third blade) 32 described below (the details are described below). The first transporting paddle 28 is located axially symmetric to the first mixing paddle 24 with respect to the first kneading axis 11. The first transporting paddle 28 is constituted with an arm 29 and blades 32, 33. The arm 29 is connected with the first kneading axis 11, and the blades 32, 33 are placed along the arm 29. The blade 32 is placed on the tip side of the arm 29. The blade 32 is formed substantially securiform as well as substantially planar. The blade 33 is placed on the side of the first kneading axis 11 and formed substantially rectangular.

[0040]

In the cases of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26, the blades 30 are placed at the tip of the arm 29, however in the case of the first transporting paddle 28, the blades 32, 33 are placed along the whole arm 29.

[0041]

The second paddle module 22 mixes and shears a mixture. The second paddle module 22 is placed in Figure 4 to the left direction of the first paddle 21.

The second paddle module 22 is constituted with the 4th mixing paddle 34 and the second shearing paddle 35. The 4th mixing paddle 34 is constituted similarly as the first mixing paddle 24. The second shearing paddle 35 is constituted similarly as the first shearing paddle 27.

[0042]

The third paddle module 23 pushes out a mixture out of a rotation range of the blade (third blade) 32 (the details are described below). The third paddle module 23 is placed further to the left direction in Figure 4 of the second paddle module 22. The third paddle module 23 is constituted with the second transporting paddle 36 and the third transporting paddle 37. The second transporting paddle 36 and the third transporting paddle 37 are placed axially symmetric to each other with respect to the first kneading axis 11. The second transporting paddle 36 and the third transporting paddle 37 are constituted similarly as the first transporting paddle 28. The second transporting paddle 36 and the third transporting paddle 37 have respectively a substantially securiform blade 32 and a substantially rectangular blade 33.

[0043]

Similar to the first kneading axis 11, the second kneading axis 12 is provided with the first paddle module 21, the second paddle module 22, and the third paddle module 23. However, with respect to the second kneading axis 12, the order of the arrangement of the first paddle module 21, the second paddle module 22, and the third paddle module 23 is different from the first kneading axis 11. Namely, although in the case of the first kneading axis 11, the first paddle module 21, the second paddle module 22, and the third paddle module 23 are arranged in the mentioned order from the side of the first drive motor 13, in the case of the second kneading axis 12 the same are arranged in the order of the third paddle module 23, the second paddle module 22, and the first paddle module 21 from the side of the

second drive motor 14.

[0044]

When the layouts of the respective paddles of the first kneading axis 11 and the respective paddles of the second kneading axis 12 are compared, at positions of the second kneading axis 12 symmetric to the first mixing paddle 24 and the first transporting paddle 28 of the first kneading axis 11, the second transporting paddle 36 and the third transporting paddle 37 are juxtaposed. Further, at positions of the second kneading axis 12 symmetric to the second mixing paddle 25 of the first kneading axis 11, the 4th mixing paddle 34 and the second shearing paddle 35 are juxtaposed.

[0045]

Meanwhile, at positions of the second kneading axis 12 symmetric to the 4th mixing paddle 34 and the second shearing paddle 35 of the first kneading axis 11, the second mixing paddle 25 and the first shearing paddle 27 are juxtaposed. Further, at positions of the second kneading axis 12 symmetric to the second transporting paddle 36 and the third transporting paddle 37 of the first kneading axis 11, the first mixing paddle 24 and the first transporting paddle 28 are juxtaposed.

[0046]

Next, the actions of the concrete mixer 8 will be described.

[0047]

Gravel, sand, cement, water, chemical admixture, *etc.* are charged respectively from a source material chute 7 or a water measuring hopper 6 to a concrete mixer 8. Blending of the same is initiated in the concrete mixer 8. More specifically, the first drive motor 13 and the second drive motor 14 as well as the first reduction gear 15 and the second reduction gear 16 are driven. By rotating the first kneading axis 11 and the second kneading axis 12, the materials are blended. In this case, as shown in Figure 5 the first kneading axis 11 is rotated clockwise (see

C1), and the second kneading axis 12 is rotated counterclockwise (see C2).

[0048]

The blending action around the first kneading axis 11 will be mainly described below. The blending action around the second kneading axis 12 is performed similarly. Since in the concrete mixer 8, the respective blades 30 of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 in the first paddle module 21 have troughs Q at a inner surface facing the first kneading axis 11. Therefore the concrete mixer 8 can mix and shear efficiently a mixture.

[0049]

Figure 7 is side views of phases of a rotation of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 seen from the side of the first drive motor 13. Figure 7 shows each phase after the first kneading axis 11 and the second kneading axis 12 have rotated by approx.  $22.5^{\circ}$  (see (a) to (d)). Figure 8 is a schematic diagram superimposing the internal surfaces of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 at each phase shown in Figure 7. A dotted line in Figure 8 shows an internal surface of each paddle.

[0050]

Referring to the figures, for example, at the bottom of the mixer main body 10 on the side of the first kneading axis 11 (refer to sign U in Figure 8), corresponding to the rotation of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26, the troughs Q of the blades 30 move with the passage of time (refer to signs T1 to T3 in Figure 8). The space in the vicinity of a trough Q moves also with time. Therefore, in the vicinity of a trough Q there appears a space that moves along the flanks of the blades 30 or moves across the trough Q of the blades 30. In other words, in the vicinity of a trough Q the space

flows irregularly generating so called turbulent flows.

[0051]

Figure 9 is a diagram showing the movement of a material at a trough Q. When the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26 are rotated, the space in the vicinity of a trough Q flows irregularly. Therefore, a material existing in the space moves by being carried along the blades 30 (refer to M1 in Figure 9), or being carried across the trough Q of the blades 30 (refer to M2 in Figure 9). When a material is transported by the blades 30, a mixture of the material is mixed and by crossing over the trough Q of the blades 30, the edge of the blades 30 rotating around the first kneading axis 11 cuts across and shears the mixture efficiently. In this regard, Figure 9 shows the material schematically for convenience of explanation, and a part of constituents are omitted.

[0052]

According to the constitution of a conventional concrete mixer 50, as shown in Figure 12, blades 56 were aligned forming a band. When a paddle 54 in the concrete mixer 50 is rotated, the moving locus of the internal surface of the blades 56 seen from the side of a drive motor 57 is substantially circular (refer to a dotted line L1 in Figure 12). Therefore, a space moved by the blades 56 moves mainly along the flank of the blades 56.

[0053]

In contrast, at the bottom U of the mixer main body 10 (refer to Figure 8), a space in the vicinity of the trough Q flows irregularly with time. Consequently, the material moves also irregularly following the space.

[0054]

Ordinarily, immediately after initiation of blending, the material is mixed due to low viscosity. Then, when the viscosity of the material develops after elapse of certain blending time, the material is sheared. In the case of a concrete mixer 8,

a space in the vicinity of the trough Q flows irregularly, mixing and shearing of the mixture can be conducted almost at the same time. Consequently, mixing and shearing of a mixture can be conducted efficiently, and the blending effect of a mixture can be enhanced.

[0055]

In a conventional constitution, a material rolls along the flank of the blades 56 to generate occasionally a "balled lump". In the concrete mixer 8, a space in the vicinity of the trough Q flows irregularly with time, and the material moves accordingly. Consequently, in the concrete mixer 8, the possibility of generation of a "balled lump" can be suppressed significantly.

[0056]

In the concrete mixer 8 the size of the blade 30 is relatively large. Consequently, in the concrete mixer 8, the number of arms 29 is made smaller than in a conventional constitution. By this means the volume of the material passing between an arm 29 and an arm 29, namely "pass of material", can be improved.

[0057]

In the concrete mixer 8, the first shearing paddle 27 is placed axially symmetric to the second mixing paddle 25 with respect to the first kneading axis 11. In the concrete mixer 8, similarly the second shearing paddle 35 is placed axially symmetric to the 4th mixing paddle 34 with respect to the first kneading axis 11. Consequently, in the concrete mixer 8, mixing and shearing of a mixture can be conducted alternately, so that the blendability can be improved.

[0058]

A material existing near the first paddle module 21 is mixed by the second mixing paddle 25. The material is sheared by the first shearing paddle 27 immediately when the first kneading axis 11 has made a half rotation. Similarly, a material existing near the second paddle module 22 is mixed by the 4th mixing

paddle 34. The material is sheared by the second shearing paddle 35 immediately when the first kneading axis 11 has made a half rotation.

[0059]

Since mixing and shearing are alternately carried out during a rotation of the first kneading axis 11 as described above, a mixture can be effectively blended. Further, since mixing and shearing are alternately repeated, a shorter blending time can be aimed at.

[0060]

In the concrete mixer 8 at a position symmetric to the first transporting paddle 28 placed on the side of the first kneading axis 11, the second transporting paddle 36 and the third transporting paddle 37 are juxtaposed. Consequently, in the concrete mixer 8 a large amount of material can be blended without congestion of the material.

[0061]

For example, as shown in Figure 10(a), a material on the side of the first kneading axis 11 is sent out by the first transporting paddle 28 to the side of the second kneading axis 12 (refer to arrow P1). At this timing, the third transporting paddle 37 on the side of the second kneading axis 12 turns downward, so that the third transporting paddle 37 is in a state for receiving the material sent out by the first transporting paddle 28.

[0062]

As shown in Figure 10(b), when the second kneading axis 12 is rotated by approx. 90°, a material existing near the third transporting paddle 37 on the side of the second kneading axis 12 is sent out by the third transporting paddle 37 to the side of the first kneading axis 11 (refer to arrow P2). At this timing, the first mixing paddle 24 on the side of the first kneading axis 11 turns downward, so that the first mixing paddle 24 is in a state for receiving the material sent out by the third

transporting paddle 37.

[0063]

Next, as shown in Figure 10(c), when the first kneading axis 11 is rotated by approx. 90°, a material existing near the first mixing paddle 24 is sent out by the first mixing paddle 24 to the axial direction (the depth direction in Figure 10) of the first kneading axis 11, because the first mixing paddle 24 has a spiral form.

[0064]

When a material is transported in the axial direction of the first kneading axis 11 as described above, there appears a space on the inner side of the first mixing paddle 24 (refer to hatched section S). At this timing, the second transporting paddle 36 on the side of the second kneading axis 12 turns downward, and another material is present near the second transporting paddle 36, because a new other material is supplied by the first paddle module 21, and the second paddle module 22 from a distal to proximal direction in Figure 10.

[0065]

As shown in Figure 10(d), when the second kneading axis 12 is rotated by approx. 90°, a material existing near the second transporting paddle 36 on the side of the second kneading axis 12 is sent out by the second transporting paddle 36 to the side of the first kneading axis 11 (refer to arrow P3). When thereafter the first kneading axis 11 is rotated by another approx. 90° as shown in Figure 10(e), (a part of) the material sent out to the side of the first kneading axis 11 is sent out by the first transporting paddle 28 to the side of the second kneading axis 12 (refer to arrow P4).

[0066]

As described above, whenever the first kneading axis 11 and the second kneading axis 12 are rotated by approx. 90° a material is transported alternately to the first kneading axis 11 and the second kneading axis 12 by the first transporting paddle 28 on the side of the first kneading axis 11 or the second transporting paddle

36 and the third transporting paddle 37 on the side of the second kneading axis 12. Consequently, in the concrete mixer 8 a large amount of material can be blended without congestion of the material.

[0067]

A material sent out by the third transporting paddle 37 to the side of the first kneading axis 11 is transported in the axial direction of the first kneading axis 11 by the first mixing paddle 24 by every revolution of the first kneading axis 11 and the second kneading axis 12. Therefore, in the concrete mixer 8, a material can be efficiently circulated in the width direction and to the depth direction shown in Figure 10. Consequently, in the concrete mixer 8 a material can be blended more efficiently.

[0068]

Further, the first transporting paddle 28, the second transporting paddle 36, and the third transporting paddle 37 prevent a mixture from sticking to the internal end surfaces of the mixer main body 10. All of the blades 32, 33 of the first transporting paddle 28, the second transporting paddle 36, and the third transporting paddle 37 are placed along the internal end surface of the mixer main body 10. Therefore, when the first transporting paddle 28, the second transporting paddle 36, and the third transporting paddle 37 are rotated, they move along the internal end surface of the mixer main body 10. Therefore the first transporting paddle 28, the second transporting paddle 36, and the third transporting paddle 37 can remove a mixture stuck to the internal end surface of the mixer main body 10 during blending.

[0069]

The scope of the invention is not limited to the above embodiment, and various modification can be made without departing from the spirit and scope of the invention. For example, the shape, size, number, structure, *etc.* of the batcher plant 1, the concrete mixer 8, the first kneading axis 11, the second kneading axis 12, the

first paddle module 21, the second paddle module 22, the third paddle module 23, the first mixing paddle 24, the second mixing paddle 25, the third mixing paddle 26, the 4th mixing paddle 34, the first shearing paddle 27, the second shearing paddle 35, the first transporting paddle 28, the second transporting paddle 36, the third transporting paddle 37, the blades 30, 31, 32, *etc.* of the Embodiment are not limited thereto and an appropriate design change is possible.

[0070]

Particularly, in the present Embodiment the first paddle module 21 is provided with 3 mixing paddles of the first mixing paddle 24, the second mixing paddle 25, and the third mixing paddle 26, however the number of mixing paddles is not limited thereto. Therefore the number of troughs Q formed between adjacent blades 30 is not limited to 2 as shown in the Embodiment.

## CLAIMS

1. A concrete mixer comprising:
  - a mixer main body which can accommodate a plurality of materials to be used as source materials for ready-mix concrete;
  - a kneading axis placed rotatably inside the mixer main body; and
  - a plurality of mixing paddles for mixing the plurality of materials;characterized in that each of the mixing paddles comprises an arm connected with the kneading axis, and a first blade placed at a tip of the arm;
  - wherein the first blades of the plurality of mixing paddles are placed forming a spiral row circumferentially around the kneading axis; and
  - there is a trough between adjacent first blades among the first blades placed in a row, such that the width of a gap between the first blades constituting the trough narrows with the distance from the kneading axis.
2. The concrete mixer according to claim 1, wherein the first blades are formed substantially arcuate, and the trough is formed by arranging the first blades placed in a row such that end faces thereof face each other.
3. The concrete mixer according to claim 1 or 2, further comprising a first shearing paddle for shearing a kneaded mixture of the plurality of materials at an axially symmetric position of any one of the plurality of mixing paddles with respect to the kneading axis, the first shearing paddle comprising a substantially securiform second blade.
4. The concrete mixer according to any one of claims 1 to 3, further comprising a first transporting paddle which has an arm connected with the kneading axis, and a substantially planar third blade provided along the flank of the arm, and is for transporting the mixture outside a rotation range of the third blade, at an axially symmetric position of the mixing paddle placed at a side in the direction of the

kneading axis of the mixer main body among the plurality of mixing paddles with respect to the kneading axis.

5. The concrete mixer according to any one of claims 1 to 4, further comprising a mixing paddle placed on the kneading axis; and a second shearing paddle which has a substantially securiform second blade, and is for shearing the mixture of a kneaded mixture of the plurality of materials, at an axially symmetric position of the mixing paddle with respect to the kneading axis.

6. The concrete mixer according to any one of claims 1 to 5, further comprising a second transporting paddle which comprises an arm connected with the kneading axis, and a substantially planar third blade placed along a flank of the arm, and is placed on the kneading axis for transporting the mixture outside a rotation range of the third blade; and

a third transporting paddle which is constituted similarly as the second transporting paddle, and is placed at an axially symmetric position of the second transporting paddle with respect to the kneading axis for transporting the mixture outside a rotation range of the third blade.

7. The concrete mixer according to claim 5 or 6, wherein two of the kneading axes are juxtaposed in the mixer main body, and

on one of the kneading axes the plurality of mixing paddles, the second shearing paddle, and the second transporting paddle are provided side by side in the mentioned order from a side in the direction of the kneading axis of the mixer main body, while

on the other kneading axis the second transporting paddle, the second shearing paddle, and the plurality of mixing paddles are provided side by side in the mentioned order from the side of the mixer main body.

8. The concrete mixer according to claim 7, wherein at a position symmetric to one of the kneading axes provided with the first transporting paddle, the second

transporting paddle is placed on the other kneading axis, wherein,

the first transporting paddle placed on the former kneading axis, and the second transporting paddle placed on the latter kneading axis rotate in the opposite direction around the kneading axes maintaining a phase difference of  $90^\circ$ .

9. A ready-mix concrete production plant provided with the concrete mixer according to any one of claims 1 to 8.