

MECHANICAL ARM DEVICE AND COATING ROBOT

The present application claims priority to Chinese Patent Application No. 202011337621.0 filed on November 25, 2020 and Chinese Patent Application No. 202011423818.6 filed on December 8, 2020, which are incorporated herein by reference in their entireties.

TECHNICAL FIELD

The present application relates to the field of mechanical arm technologies, and for example, to a mechanical arm device and a coating robot.

BACKGROUND

Currently, coating robots generally supply materials by using hoses. A mixing component is arranged at a tail end of a mechanical arm of a coating robot, and a feeding component is connected to the mixing component through a hose, so as to supply materials to the mixing component through the hose. The foregoing arrangement has the following problems: When the mechanical arm moves, because the position of the mixing component changes, the hose is prone to deformation such as bending with the movement of the mechanical arm, and the deformation of the hose may affect normal supply of the material.

SUMMARY

The present application provides a mechanical arm device and a coating robot. A delivery pipe assembly of the mechanical arm device can adapt to movement of a mechanical arm, which resolves the problem that material feeding pipes are prone to deformation during the movement of the mechanical arm, and ensures normal supply of materials.

According to an aspect of the present application, provided is a mechanical arm device, including: a base; a mechanical arm connected to the base and configured to be rotatable relative to the base; and a delivery pipe assembly arranged on the mechanical arm, where the delivery pipe assembly is configured to be rotatable relative to the base, and at least a portion of the delivery pipe assembly moves synchronously with the mechanical arm; the delivery pipe assembly includes multiple material feeding pipes pivotally connected in sequence, and internal cavities of two adjacent material feeding pipes communicate with each other. The mechanical arm and the delivery pipe assembly are configured to be rotatable relative to the base, so that when the mechanical arm rotates

relative to the base, the delivery pipe assembly can rotate with the mechanical arm relative to the base. In addition, because the multiple material feeding pipes of the delivery pipe assembly are pivotally connected in sequence, the delivery pipe assembly can adapt to the movement of the mechanical arm, so that the delivery pipe assembly moves synchronously with the mechanical arm.

5 This can avoid deformation of the material feeding pipes during the movement of the mechanical arm, and ensure normal supply of materials.

According to another aspect of the present application, provided is a coating robot, including a mixer and the foregoing mechanical arm device, where the last material feeding pipe among multiple material feeding pipes in a material feeding direction communicates with the mixer, and the mixer
10 forms a mixing component. The mixer is configured to mix materials, and the material feeding pipe of the mechanical arm device communicates with the mixer to supply the materials to the mixer.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic diagram of a three-dimensional structure of an embodiment of a coating robot according to the present application at an angle;

15 FIG. 2 is a schematic diagram of the three-dimensional structure of the coating robot in FIG. 1 at another angle;

FIG. 3 is a schematic diagram of the three-dimensional structure of the coating robot in FIG. 1 at another angle;

20 FIG. 4 is a schematic diagram of the three-dimensional structure of the coating robot in FIG. 1 at another angle;

FIG. 5 is a front view of the coating robot in FIG. 1;

FIG. 6 is a top view of the coating robot in FIG. 5;

FIG. 7 is a bottom view of the coating robot in FIG. 5;

FIG. 8 is a right view of the coating robot in FIG. 5;

25 FIG. 9 is a left view of the coating robot in FIG. 5;

FIG. 10 is a schematic structural diagram showing connection between a connecting assembly and arm bodies of a mechanical arm of the coating robot in FIG. 1;

FIG. 11 is a schematic diagram of a three-dimensional structure of a first rotary joint of the coating robot in FIG. 1;

FIG. 12 is a sectional view of the first rotary joint in FIG. 11;

FIG. 13 is a left view of the first rotary joint in FIG. 11;

FIG. 14 is a top view of the first rotary joint in FIG. 11;

FIG. 15 is a schematic diagram of a three-dimensional structure of a second rotary joint of the
5 coating robot in FIG. 1;

FIG. 16 is a sectional view of the second rotary joint in FIG. 15;

FIG. 17 is a left view of the second rotary joint in FIG. 15;

FIG. 18 is a bottom view of the second rotary joint in FIG. 15;

FIG. 19 is a top view of the second rotary joint in FIG. 15;

10 FIG. 20 is a schematic diagram of a three-dimensional structure of a third rotary joint of the coating robot in FIG. 1;

FIG. 21 is a schematic diagram of the three-dimensional structure of the third rotary joint in FIG. 20 at another angle;

FIG. 22 is a sectional view of the third rotary joint in FIG. 20;

15 FIG. 23 is a left view of the third rotary joint in FIG. 20;

FIG. 24 is a right view of the third rotary joint in FIG. 20;

FIG. 25 is a bottom view of the third rotary joint in FIG. 20;

FIG. 26 is a top view of the third rotary joint in FIG. 20;

20 FIG. 27 is a schematic structural diagram of a mixer according to an embodiment of the present application;

FIG. 28 is a sectional view taken along line A-A in FIG. 27; and

FIG. 29 is a sectional view taken along line B-B in FIG. 27.

The foregoing accompanying drawings include the following reference numerals:

10. Base; 11. Pipeline support; 20. Mechanical arm; 21. Arm body; 30. Delivery pipe assembly;
25 31. Material feeding pipe; 40. First rotary joint; 41. First rotating sleeve; 411. First channel; 412. Third channel; 42. First rotating shaft; 421. Second channel; 422. Fourth channel; 43. First bearing; 44. First sealing member; 45. First fastener; 50. Second rotary joint; 51. Second rotating sleeve; 511. First flow channel; 512. Third flow channel; 52. Second rotating shaft; 521. Second flow channel; 522. Fourth flow channel; 53. Second bearing; 54. Second sealing member; 55. Second fastener; 60.

Third rotary joint; 61. Third rotating sleeve; 611. First cavity; 612. Second through hole; 62. Third rotating shaft; 621. Second cavity; 622. First through hole; 623. End cover; 63. First flange; 631. Third cavity; 64. Third bearing; 65. Third sealing member; 66. Second flange; 70. Connecting assembly; 71. Hoop; 72. Connecting ring; 73. First connecting plate; 74. Sliding slot; 75. First connecting rod; 76. Second connection rod; 80. Mixer; 91. First pipe joint; 92. Second pipe joint; 93. Third pipe joint; 95. Fifth pipe joint; 96. Discharge pipe; 100. First driving portion;

81. Supporting body; 811. First flow passage; 8111. First opening; 8112. Second opening; 8113. Third opening; 812. Second flow passage;

82. Mixing pipe; 821. Abutting portion;

83. Stirring assembly; 831. Rotating shaft; 832. Stirring member; 833. U-shaped buckle;

84. Framework oil seal;

85. First bearing;

86. Fixing cylinder; 861. Supporting portion; 862. Bearing portion; 863. Connecting portion;

87. Sealing ring;

88. Driving assembly;

89. Transmission assembly; 891. Driving gear; 892. Driven gear; 893. Intermediate gear; 894. Second bearing; and 895. Connecting shaft.

DESCRIPTION OF EMBODIMENTS

In the description of the present application, unless otherwise explicitly specified and limited, the terms "connect to", "connect" and "fix" should be broadly understood, for example, they may be a fixed connection or a detachable connection or be integrated; or may be a mechanical connection or an electrical connection; or may be a direct connection to each other, or may be an indirect connection to each other through an intermediate medium, or may be internal communication between two elements or an interaction relationship between two elements. For a person of ordinary skills in the art, the specific meanings of the foregoing terms in the present application may be understood based on specific circumstances.

In the present application, unless otherwise specified and limited, that a first feature is "above" or "below" a second feature may include that the first feature is in direct contact with the second feature, or that the first feature and the second feature are not in direct contact, but in contact through

another feature therebetween. In addition, that the first feature is "above" the second feature includes that the first feature is over or obliquely above the second feature, or only indicates that the first feature has a horizontal height greater than that of the second feature. That the first feature is "below" the second feature includes that the first feature is under or obliquely below the second feature, or
5 only indicates that the first feature has a horizontal height less than that of the second feature.

In the description of the embodiments, direction or position relationships indicated by terms such as "upper", "lower", and "right" are direction or position relationships based on the accompanying drawings, and are merely intended to facilitate the description and simplify operation, rather than indicating or implying that a referred apparatus or element must have a particular direction
10 or be constructed or operated in a particular direction. Therefore, these terms cannot be construed as limiting the present application. In addition, the terms "first" and "second" are only used to distinguish in description and have no special meanings.

It should be noted that the embodiments in the present application and features in the embodiments may be combined with each other when no conflict occurs.

15 It should be noted that unless otherwise specified, all technical and scientific terms used in the present application have the same meanings as commonly understood by a person of ordinary skill in the art to which the present application belongs.

In the present application, unless stated to the contrary, locative words such as "up", "down", "top", and "bottom" are usually used for the directions shown in the accompanying drawings, or for
20 components in the vertical, perpendicular or gravity directions. Similarly, to facilitate understanding and description, "inside" and "outside" refer to the inside and outside relative to the outline of each component, but the foregoing locative words are not used to limit the present application.

In view of the problem that a hose is prone to deformation with the movement of a mechanical arm, which affects normal supply of materials, the present application and an embodiment of the
25 present application provide a mechanical arm device.

As shown in FIG. 1 to FIG. 7, in this embodiment of the present application, the mechanical arm device includes a base 10, a mechanical arm 20, and a delivery pipe assembly 30, where the mechanical arm 20 is connected to the base 10, and the mechanical arm 20 is configured to be rotatable relative to the base 10; the delivery pipe assembly 30 is arranged on the mechanical arm 20,

the delivery pipe assembly 30 is configured to be rotatable relative to the base 10, and at least a portion of the delivery pipe assembly 30 moves synchronously with the mechanical arm 20; the delivery pipe assembly 30 includes multiple material feeding pipes 31 pivotally connected in sequence, and internal cavities of two adjacent material feeding pipes 31 communicate with each other. For example, a first end of the mechanical arm 20 is connected to the base 10, and a second end of the mechanical arm 20 is connected to a mixing component; in a material feeding direction, the first material feeding pipe 311 among the multiple material feeding pipes 31 is arranged on the base 10 and connected to a feeding component, and the last material feeding pipe 314 among the multiple material feeding pipes 31 is connected to the mixing component.

To facilitate description, in this embodiment, referring to FIG. 3, in the material feeding direction, the multiple material feeding pipes 31 are the first material feeding pipe 311 among the multiple material feeding pipes, the second material feeding pipe 312 adjacent to the first material feeding pipe 311, the last material feeding pipe 314 among the multiple material feeding pipes, and an intermediate material feeding pipe 313 located between the second material feeding pipe 312 and the last material feeding pipe 314.

In the foregoing arrangement, the mechanical arm 20 and the delivery pipe assembly 30 are configured to be rotatable relative to the base 10, and the mechanical arm 20 and the delivery pipe assembly 30 are connected to the mixing component. Therefore, when the mechanical arm 20 rotates relative to the base 10, the delivery pipe assembly 30 can rotate with the mechanical arm 20 relative to the base 10. In addition, because the multiple material feeding pipes 31 of the delivery pipe assembly 30 are pivotally connected in sequence, the delivery pipe assembly 30 can adapt to the movement of the mechanical arm 20, so that the delivery pipe assembly 30 moves synchronously with the mechanical arm 20. This can avoid deformation of the material feeding pipes 31 during the movement of the mechanical arm 20, and ensure normal supply of materials (e.g., ensure that the supply of the materials meets requirements of a user).

The movement of the mechanical arm 20 can drive the mixing component to move, so that the position of the mixing component changes, and adaptability of the mechanical arm device and the mixing component is improved.

The multiple material feeding pipes 31 are pivotally connected in sequence, and internal cavities

of two adjacent material feeding pipes 31 communicate with each other, so that the delivery pipe assembly 30 can adapt to the movement of the mechanical arm 20, deformation of the material feeding pipes 31 is avoided, and the materials are conveyed to the mixing component, thereby ensuring normal supply of the materials.

5 The first end of the mechanical arm 20 is connected to the base 10, and the second end of the mechanical arm 20 is connected to the mixing component, the first material feeding pipe 311 among the multiple material feeding pipes 31 in the material feeding direction is arranged on the base 10, and the last material feeding pipe 314 among the multiple material feeding pipes 31 in the material feeding direction is connected to the mixing component. Through such an arrangement, the delivery
10 pipe assembly 30 can be stably connected to the base 10 and the mechanical arm 20, and the feeding component conveys the materials to the material feeding pipes 31, and the material feeding pipes 31 convey the materials to the mixing component, thereby implementing the stable supply of the materials.

 The foregoing synchronous movement of at least a portion of the delivery pipe assembly 30 and
15 the mechanical arm 20 means that at least a portion of the delivery pipe assembly 30 can move with the mechanical arm 20, where the delivery pipe assembly 30 has a degree of freedom greater than or equal to that of the mechanical arm 20.

 In this embodiment of the present application, an outermost material feeding pipe 31 at an upstream position among the multiple material feeding pipes 31 means the first material feeding pipe
20 311 among the multiple material feeding pipes 31 in the material feeding direction, and an outermost material feeding pipe 31 at a downstream position among the multiple material feeding pipes 31 means the last material feeding pipe 314 among the multiple material feeding pipes 31 in the material feeding direction.

 In this embodiment of the present application, the first end of the mechanical arm 20 is
25 connected to the base 10, and the second end of the mechanical arm 20 is connected to a mixing component; in the material feeding direction, the outermost material feeding pipe 311 at the upstream position among the multiple material feeding pipes 31 is arranged on the base 10 and connected to the feeding component, and the outermost material feeding pipe 314 at the downstream position among the multiple material feeding pipes 31 is connected to the mixing component. In an alternative

embodiment of the present application, based on actual requirements, the delivery pipe assembly 30 including the multiple material feeding pipes 31 may be directly arranged on the mechanical arm 20, the outermost material feeding pipe 311 at the upstream position is connected to the feeding component, and the outermost material feeding pipe 314 at the downstream position is connected to the mixing component. The feeding component may be arranged on the base 10 or at a corresponding position of the mechanical arm 20, and the mixing component may be arranged at an end of the mechanical arm 20 away from the base 10 or at any other position of the mechanical arm 20 (e.g., the mixing component may be arranged on a middle joint of the mechanical arm 20), as long as the feeding component can communicate with the outermost material feeding pipe 311 at the upstream position among the multiple material feeding pipes 31, and the outermost material feeding pipe 314 at the downstream position among the multiple material feeding pipes 31 can communicate with the mixing component to supply the materials.

Optionally, as shown in FIG. 1 and FIG. 2, in this embodiment of the present application, the mechanical arm 20 is a four-axis mechanical arm. In an alternative embodiment not shown in the accompanying drawings of the present application, a two-axis mechanical arm, a three-axis mechanical arm or a mechanical arm with at least five axes may be selected as the mechanical arm 20 in the present application based on actual requirements.

As shown in FIG. 1 and FIG. 9, in this embodiment of the present application, a central axis of rotation of the delivery pipe assembly 30 relative to the base 10 is parallel to a central axis of rotation of the mechanical arm 20 relative to the base 10, so that the delivery pipe assembly 30 and the mechanical arm 20 have a same movement trend.

Through the foregoing arrangement, when the mechanical arm 20 rotates relative to the base 10, the delivery pipe assembly 30 can rotate with the mechanical arm 20 relative to the base 10, so that the delivery pipe assembly 30 moves synchronously with the mechanical arm 20, and the delivery pipe assembly 30 and the mechanical arm 20 have the same movement trend, which can avoid deformation of the material feeding pipes 31 during the movement of the mechanical arm 20, thereby ensuring normal supply of materials.

Optionally, as shown in FIG. 1 and FIG. 9, in this embodiment of the present application, the central axis of rotation of the mechanical arm 20 relative to the base 10 includes a first axis and a

second axis. That a central axis of rotation of the delivery pipe assembly 30 relative to the base 10 is parallel to a central axis of rotation of the mechanical arm 20 relative to the base 10 includes: The central axis of rotation of the first material feeding pipe 311 among the multiple material feeding pipes in the material feeding direction relative to the base 10 through a first rotary joint 40 is parallel to the first axis, and the axis of rotation of the second material feeding pipe 312 adjacent to the first material feeding pipe 31 relative to the first material feeding pipe 31 through a second rotary joint 50 is parallel to the second axis.

As shown in FIG. 1 to FIG. 9, in this embodiment of the present application, the mechanical arm 20 includes multiple arm bodies 21 that are sequentially connected to each other, two adjacent arm bodies 21 are pivotally connected to each other, and the multiple arm bodies 21 are arranged corresponding to the multiple material feeding pipes 31.

In the foregoing arrangement, the multiple arm bodies 21 are pivotally connected in sequence, which enables the mechanical arm 20 to move flexibly, so that the mechanical arm 20 drives the mixing component to move flexibly, improving the adaptability and operation range of the mechanical arm device. The multiple arm bodies 21 are arranged corresponding to the multiple material feeding pipes 31, so that the multiple material feeding pipes 31 can move with the multiple arm bodies 21. This improves synchronization of the movement between the delivery pipe assembly 30 and the mechanical arm 20, and can prevent the material feeding pipes 31 from deforming during movement with the mechanical arm 20, thereby ensuring normal supply of materials.

That the multiple arm bodies 21 are arranged corresponding to the multiple material feeding pipes 31 means that one of the multiple arm bodies 21 is arranged corresponding to at least one material feeding pipe 31. The number of the arm bodies 21 and the number of the material feeding pipes 31 may be set based on actual requirements, as long as it is ensured that at least a portion of the delivery pipe assembly 30 can move with the mechanical arm 20 and the delivery pipe assembly 30 does not deform. Optionally, the delivery pipe assembly 30 has a degree of freedom greater than or equal to that of the mechanical arm 20. Optionally, the number of the material feeding pipes 31 is greater than or equal to that of the arm bodies 21.

As shown in FIG. 6, in this embodiment of the present application, the delivery pipe assembly 30 and the mechanical arm 20 are arranged in a front-rear direction. Such an arrangement can avoid

mutual interference between the delivery pipe assembly 30 and the mechanical arm 20, and ensure that the delivery pipe assembly 30 can move synchronously with the mechanical arm 20.

As shown in FIG. 6, in this embodiment of the present application, among the multiple material feeding pipes 31, the first material feeding pipe 311 and the last material feeding pipe 314 in the material feeding direction are arranged in the front-rear direction, and material feeding pipes 31 located between the first material feeding pipe 311 and the last material feeding pipe 314 are arranged in a left-right direction.

Through the foregoing arrangement, the delivery pipe assembly 30 and the mechanical arm 20 can be arranged in the front-rear direction, thereby avoiding mutual interference between the delivery pipe assembly 30 and the mechanical arm 20, and ensuring that the delivery pipe assembly 30 can move synchronously with the mechanical arm 20.

As shown in FIG. 6, in this embodiment of the present application, the foregoing front-rear direction means a direction perpendicular to a walking direction of the mechanical arm device, and the foregoing left-right direction means the walking direction of the mechanical arm device.

Optionally, in this embodiment of the present application, the material feeding pipes 31 located between the first material feeding pipe 311 and the last material feeding pipe 314 move synchronously with the mechanical arm 20. The material feeding pipes 31 located between the first material feeding pipe 311 and the last material feeding pipe 314 can adapt to the movement of the mechanical arm 20, avoiding deformation of the material feeding pipes 31 during the movement of the mechanical arm 20, and ensuring normal supply of materials.

Optionally, in this embodiment of the present application, the mechanical arm device further includes a rotary connector, where the delivery pipe assembly 30 is pivotally connected to the base 10 through the rotary connector.

In the foregoing arrangement, the delivery pipe assembly 30 is pivotally connected to the base 10 through the first rotary joint 40 and the second rotary joint 50, so that the delivery pipe assembly 30 can rotate relative to the base 10.

As shown in FIG. 1 and FIG. 9, in this embodiment of the present application, the mechanical arm 20 is rotatably arranged around a first axis of the base 10, the outermost material feeding pipe 311 at the upstream position is pivotally connected to the base 10 through the first rotary joint 40,

and the central axis of rotation of the outermost material feeding pipe 311 at the upstream position relative to the base 10 through the first rotary joint 40 is parallel to the first axis.

In the foregoing arrangement, the outermost material feeding pipe 311 at the upstream position can rotate relative to the base 10 through the first rotary joint 40, so that the delivery pipe assembly 30 can rotate relative to the base 10. The central axis of rotation of the outermost material feeding pipe 311 at the upstream position relative to the base 10 through the first rotary joint 40 forms the central axis of rotation of the delivery pipe assembly 30 relative to the base 10. Through the foregoing arrangement, the entire delivery pipe assembly 30 can move synchronously with the mechanical arm 20, avoiding deformation of the material feeding pipes 31 during the movement of the mechanical arm 20, thereby ensuring normal supply of materials.

As shown in FIG. 11 to FIG. 14, in this embodiment of the present application, the first rotary joint 40 includes a first rotating sleeve 41 and a first rotating shaft 42, where the first rotating sleeve 41 is provided with a first channel 411, the first rotating shaft 42 is pivotally connected to the first rotating sleeve 41, the first rotating shaft 42 is provided with a second channel 421 communicating with the first channel 411, a center line of the first channel 411 is parallel to a center line of the second channel 421, and the outermost material feeding pipe 311 at the upstream position communicates with the feeding component through the first channel 411 and the second channel 421.

In this embodiment of the present application, the outermost material feeding pipe 311 at the upstream position is connected to the first rotating sleeve 41, so that the material feeding pipe 311 communicates with the first channel 411, and the material feeding pipe 311 can rotate relative to the first rotating shaft 42; the first rotating shaft 42 is arranged on the base 10, so that the material feeding pipe 311 can rotate relative to the base 10, then the delivery pipe assembly 30 can rotate relative to the base 10, and therefore the delivery pipe assembly 30 can move with the mechanical arm 20, thereby avoiding deformation of the material feeding pipes 31 and ensuring normal supply of materials. The feeding component conveys the materials to the material feeding pipe 311 through the second channel 421 and the first channel 411, so that the delivery pipe assembly 30 supplies the materials to the mixing component, thereby implementing material supply to the mixing component. The center line of the first channel 411 is set parallel to the center line of the second channel 421, so that stability of material supply to the material feeding pipe 311 through the first rotary joint 40 can

be ensured, and normal and stable supply of materials is ensured.

In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the outermost material feeding pipe 311 at the upstream position may be connected to the first rotating shaft 42, and the first rotating sleeve 41 is arranged on the base 10, so that the material feeding pipe 311 is configured to be rotatable relative to the base 10. In this case, the material feeding pipe 311 communicates with the feeding component through the second channel 421 and the first channel 411.

In this embodiment of the present application, the first rotating sleeve 41 of the first rotary joint 40 further has a third channel 412 communicating with the first channel 411, and the first rotating shaft 42 further has a fourth channel 422 communicating with the second channel 421. The third channel 412 communicates with the fourth channel 422, so that the first channel 411 communicates with the second channel 421, and the outermost material feeding pipe 311 at the upstream position communicates with the feeding component through the first channel 411, the third channel 412, the fourth channel 422, and the second channel 421.

Optionally, in this embodiment of the present application, as shown in FIG. 12, the third channel 412 has a radial dimension the same as that of the fourth channel 422, so that the materials flowing from the fourth channel 422 to the third channel 412 are subjected to relatively small resistance, and therefore the materials can smoothly enter the third channel 412 from the fourth channel 422, and then flow to the first material feeding pipe 311. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the third channel 412 may have a radial dimension greater than that of the fourth channel 422, or the third channel 412 may have a radial dimension less than that of the fourth channel 422.

Optionally, there is an included angle between the center line of the first channel 411 and the center line of the third channel 412. Optionally, in this embodiment of the present application, there is an included angle of 90° between the center line of the first channel 411 and the center line of the third channel 412. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the included angle between the center line of the first channel 411 and the center line of the third channel 412 may be set to a different angle, such as 60° or 120° .

Optionally, there is an included angle between the center line of the second channel 421 and a center line of the fourth channel 422. Optionally, in this embodiment of the present application, there is an included angle of 90° between the center line of the second channel 421 and the center line of the fourth channel 422. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the included angle between the center line of the second channel 421 and the center line of the fourth channel 422 may be set to a different angle, such as 60° or 120° .

Optionally, the first rotary joint 40 further includes a first bearing 43 arranged between the first rotating sleeve 41 and the first rotating shaft 42, and the first rotating sleeve 41 is pivotally connected to the first rotating shaft 42 through the first bearing 43, so that the first rotating sleeve 41 and the first rotating shaft 42 can rotate relative to each other.

Optionally, the first rotary joint 40 further includes a first sealing member 44 arranged between the first rotating sleeve 41 and the first rotating shaft 42, the first sealing member 44 is configured to seal a gap between the first rotating sleeve 41 and the first rotating shaft 42 to prevent a material loss, and can reduce material loss. For example, during the rotation of the first rotating sleeve 41 and the first rotating shaft 42 relative to each other, the first sealing member 44 can seal the first rotating sleeve 41 and the first rotating shaft 42 to reduce the material loss. Optionally, the first sealing member 44 may be a framework oil seal.

Optionally, the first rotary joint 40 further includes a first fastener 45 arranged between the first rotating sleeve 41 and the first rotating shaft 42, and the first fastener 45 is configured to fix the first bearing 43, to prevent the first bearing 43 from sliding along a pivot axis of the first rotating shaft 42 and the first rotating sleeve 41, and stabilize rotation of the first rotating shaft 42 and the first rotating sleeve 41 relative to each other. Optionally, the first fastener 45 may be a snap spring.

Optionally, the mechanical arm device further includes a first pipe joint 91 connected to the first rotating sleeve 41, the first pipe joint 91 is connected to an end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412, and the outermost material feeding pipe 311 at the upstream position is connected to the first rotating sleeve 41 through the first pipe joint 91.

Optionally, the first pipe joint 91 is connected to the end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412 through a locking member. Optionally, the locking

member may be a bolt.

Optionally, a sealing ring is arranged between the first pipe joint 91 and the end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412, and the sealing ring is configured to seal a gap between the first pipe joint 91 and the first rotating sleeve 41 to prevent a material loss. Optionally, the sealing ring may be an O-shaped sealing ring.

Optionally, an inner wall of the first pipe joint 91 is provided with a first internal thread, the outermost material feeding pipe 311 at the upstream position is provided with a first external thread matching the first internal thread, and the first pipe joint 91 is in threaded connection with the outermost material feeding pipe 311 at the upstream position.

Optionally, the mechanical arm device further includes a second pipe joint 92 connected to the first rotating shaft 42, the second pipe joint 92 is connected to an end of the second channel 421 of the first rotating shaft 42 away from the fourth channel 422, the second pipe joint 92 is connected to the feeding component, and the feeding component is connected to the first rotating shaft 42 through the second pipe joint 92.

The manner of connection between the second pipe joint 92 and the end of the second channel 421 of the first rotating shaft 42 away from the fourth channel 422 may be the same as that between the first pipe joint 91 and the end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412, and the manner of connection between the second pipe joint 92 and the feeding component may be the same as that between the first pipe joint 91 and the outermost material feeding pipe 311 at the upstream position. Details are not described herein again.

Optionally, the mechanical arm device further includes a feeding pipe connected to the feeding component, an end of the feeding pipe away from the feeding component is connected to the first rotating shaft 42 of the first rotary joint 40 through the second pipe joint 92, and the feeding component conveys materials to the first rotary joint 40 through the feeding pipe, thereby supplying the materials to the mixing component through the delivery pipe assembly 30. Optionally, the manner of connection between the second pipe joint 92 and the feeding pipe may be the same as that between the first pipe joint 91 and the outermost material feeding pipe 311 at the upstream position. Details are not described herein again.

As shown in FIG. 1 and FIG. 9, in this embodiment of the present application, the mechanical

arm 20 is rotatably arranged around a second axis of the base 10, the first axis is perpendicular to the second axis, the rotary connector further includes a second rotary joint 50, the first material feeding pipe 311 among the multiple material feeding pipes in the material feeding direction is pivotally connected to a second material feeding pipe 312 adjacent to this material feeding pipe 311 through the second rotary joint 50, and an axis of rotation of the second material feeding pipe 312 relative to the first material feeding pipe 311 through the second rotary joint 50 is parallel to the second axis.

In the foregoing arrangement, the first material feeding pipe 311 among the multiple material feeding pipes in the material feeding direction is connected to the second material feeding pipe 312 adjacent thereto through the second rotary joint 50, so that the first material feeding pipe 311 and the second material feeding pipe 312 adjacent thereto can rotate relative to each other, and because the axis of rotation of the second material feeding pipe 312 relative to the first material feeding pipe 311 is parallel to the second axis, the delivery pipe assembly 30 can adapt to the movement of the mechanical arm 20, thereby avoiding deformation of the material feeding pipes 31, and ensuring normal supply of materials.

As shown in FIG. 15 to FIG. 19, in this embodiment of the present application, the second rotary joint 50 includes a second rotating sleeve 51 and a second rotating shaft 52, where the second rotating sleeve 51 is provided with a first flow channel 511, and the second rotating shaft 52 is pivotally connected to the second rotating sleeve 51. The second rotating shaft 52 is provided with a second flow channel 521 communicating with the first flow channel 511, and a center line of the first flow channel 511 is perpendicular to a center line of the second flow channel 521. The outermost material feeding pipe 311 at the upstream position communicates with the second flow channel 521, and the material feeding pipe 312 adjacent to the outermost material feeding pipe 311 at the upstream position communicates with the first flow channel 511.

In the foregoing arrangement, the first material feeding pipe 311 among the multiple material feeding pipes in the material feeding direction conveys materials to the second material feeding pipe 312 adjacent to the first material feeding pipe 311 through the second flow channel 521 and the first flow channel 511, thereby supplying, through the delivery pipe assembly 30, the materials to a component to which the materials are to be supplied. The center line of the first flow channel 511 is set perpendicular to the center line of the second flow channel 521, so that two adjacent material

feeding pipes 31 connected by the second rotary joint 50 are perpendicular to each other, thereby changing the material feeding direction, making the delivery pipe assembly 30 better adapt to the mechanical arm 20, avoiding deformation of the material feeding pipes 31 during the movement of the mechanical arm 20, and ensuring normal supply of materials.

5 In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the outermost material feeding pipe 311 at the upstream position may be connected to the second rotating sleeve 51, and the material feeding pipe 312 adjacent to the outermost material feeding pipe 311 at the upstream position is connected to the second rotating shaft 52, so that the two adjacent material feeding pipes 31 connected by the second
10 rotary joint 50 can rotate relative to each other. In this case, the outermost material feeding pipe 311 at the upstream position communicates with the first flow channel 511, the material feeding pipe 312 adjacent to the outermost material feeding pipe 311 at the upstream position communicates with the second flow channel 521, and the outermost material feeding pipe 311 at the upstream position communicates with the material feeding pipe 312 adjacent thereto through the second rotary joint 50.

15 For example, in this embodiment of the present application, the second rotating sleeve 51 of the second rotary joint 50 further has a third flow channel 512 communicating with the first flow channel 511, and the second rotating shaft 52 further has a fourth flow channel 522 communicating with the second flow channel 521. The third flow channel 512 communicates with the fourth flow channel 522, so that the first flow channel 511 communicates with the second flow channel 521. The
20 outermost material feeding pipe 311 at the upstream position conveys materials to the material feeding pipe 312 adjacent to the outermost material feeding pipe 311 at the upstream position through the second flow channel 521, the fourth flow channel 522, the third flow channel 512, and the first flow channel 511.

Optionally, in this embodiment of the present application, the third flow channel 512 has a radial
25 dimension the same as that of the fourth flow channel 522, so that the materials flowing from the fourth flow channel 522 to the third flow channel 512 are subjected to relatively small resistance, and therefore the materials can smoothly enter the third flow channel 512 from the fourth flow channel 522, and then flow to the material feeding pipe 31. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the third

flow channel 512 may have a radial dimension greater than that of the fourth flow channel 522, or the third flow channel 512 may have a radial dimension less than that of the fourth flow channel 522.

Optionally, there is an included angle between the center line of the first flow channel 511 and the center line of the third flow channel 512. Optionally, in this embodiment of the present application, there is an included angle of 90° between the center line of the first flow channel 511 and the center line of the third flow channel 512. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the included angle between the center line of the first flow channel 511 and the center line of the third flow channel 512 may be set to a different angle, such as 60° or 120° .

Optionally, there is an included angle between the center line of the second flow channel 521 and the center line of the fourth flow channel 522. Optionally, in this embodiment of the present application, there is an included angle of 180° between the center line of the second flow channel 521 and the center line of the fourth flow channel 522. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the included angle between the center line of the second flow channel 521 and the center line of the fourth flow channel 522 may be set to a different angle, such as 120° or 150° .

Optionally, in this embodiment of the present application, the second rotary joint 50 further includes a second bearing 53 arranged between the second rotating sleeve 51 and the second rotating shaft 52, and the second rotating sleeve 51 is pivotally connected to the second rotating shaft 52 through the second bearing 53, so that the second rotating sleeve 51 and the second rotating shaft 52 can rotate relative to each other.

Optionally, in this embodiment of the present application, the second rotary joint 50 further includes a second sealing member 54 arranged between the second rotating sleeve 51 and the second rotating shaft 52. The second sealing member 54 has a function the same as that of the first sealing member 44 arranged between the first rotating sleeve 41 and the first rotating shaft 42. Details are not described herein again. Optionally, the second sealing member 54 may be a framework oil seal.

Optionally, in this embodiment of the present application, the second rotary joint 50 further includes a second fastener 55 arranged between the second rotating sleeve 51 and the second rotating shaft 52. The second fastener 55 has a function the same as that of the first fastener 45 arranged

between the first rotating sleeve 41 and the first rotating shaft 42. Details are not described herein again. Optionally, the second fastener 55 may be a snap spring.

Optionally, in this embodiment of the present application, the mechanical arm device further includes a third pipe joint 93 connected to the second rotating sleeve 51, the third pipe joint 93 is connected to an end of the first flow channel 511 of the second rotating sleeve 51 away from the third flow channel 512, the material feeding pipe 312 adjacent to the outermost material feeding pipe 311 at the upstream position is connected to the third pipe joint 93, and the material feeding pipe 312 adjacent to the outermost material feeding pipe 311 at the upstream position is connected to the second rotating sleeve 51 through the third pipe joint 93.

Optionally, in this embodiment of the present application, the manner of connection between the third pipe joint 93 and the end of the first flow channel 511 of the second rotating shaft 51 away from the third flow channel 512 may be the same as that between the first pipe joint 91 and the end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412, and the manner of connection between the material feeding pipe 312 adjacent to the outermost material feeding pipe 311 at the upstream position and the third pipe joint 93 may be the same as that between the first pipe joint 91 and the outermost material feeding pipe 311 at the upstream position. Details are not described herein again.

Optionally, the mechanical arm device further includes a fourth pipe joint connected to the second rotating shaft 52, the fourth pipe joint is connected to an end of the second flow channel 521 of the second rotating shaft 52 away from the fourth flow channel 522, the fourth pipe joint is connected to the outermost material feeding pipe 311 at the upstream position, and the outermost material feeding pipe 311 at the upstream position is connected to the second rotating shaft 52 through the fourth pipe joint.

Optionally, the manner of connection between the fourth pipe joint and the end of the second flow channel 521 of the second rotating shaft 52 away from the fourth flow channel 522 may be the same as that between the first pipe joint 91 and the end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412, and the manner of connection between the fourth pipe joint and the outermost material feeding pipe 311 at the upstream position may be the same as that between the first pipe joint 91 and the outermost material feeding pipe 311 at the upstream position.

Details are not described herein again.

As shown in FIG. 2 to FIG. 5, FIG. 7, and FIG. 8, in this embodiment of the present application, the mechanical arm device further includes a third rotary joint 60, and the outermost material feeding pipe 314 at the downstream position communicates with the mixing component through the third rotary joint 60.

In the foregoing arrangement, the outermost material feeding pipe 314 at the downstream position and the mixing component are both connected to the third rotary joint 60, and the outermost material feeding pipe 314 at the downstream position supplies materials to the mixing component through the third rotary joint 60, thereby implementing material supply to the mixing component.

As shown in FIG. 20 to FIG. 26, in this embodiment of the present application, the third rotary joint 60 includes a third rotating sleeve 61, a third rotating shaft 62, and a first flange 63. The third rotating sleeve 61 is provided with a first cavity 611, and the third rotating shaft 62 penetrates into the third rotating sleeve 61. The third rotating shaft 62 is pivotally connected to the third rotating sleeve 61, and the third rotating shaft 62 is provided with a second cavity 621 communicating with the first cavity 611. The first flange 63 is connected to the third rotating shaft 62, and the first flange 63 is provided with a third cavity 631 communicating with the second cavity 621. A center line of the third cavity 631 is parallel to a center line of the first cavity 611, the outermost material feeding pipe 314 at the downstream position communicates with the first cavity 611, and the mixing component communicates with the third cavity 631.

In the foregoing arrangement, the outermost material feeding pipe 314 at the downstream position is connected to the third rotating sleeve 61, and the mixing component is connected to the first flange 63. Because the third rotating sleeve 61 and the third rotating shaft 62 can rotate relative to each other, the first flange 63 connected to the third rotating shaft 62 and the third rotating sleeve 61 can rotate relative to each other. Therefore, the outermost material feeding pipe 314 at the downstream position and the mixing component can rotate relative to each other, and the rotation of the mixing component relative to the outermost material feeding pipe 314 at the downstream position can expand the moving range of the mixing component and increase the operation range of the mixing component.

For example, the outermost material feeding pipe 314 at the downstream position conveys the

materials to the mixing component through the first cavity 611, the second cavity 621, and the third cavity 631, which ensures normal supply of the materials.

For example, the center line of the third cavity 631 is parallel to the center line of the first cavity 611, so that the materials can be supplied stably. Optionally, the third rotating sleeve 61 is provided with a second through hole 612 communicating with the first cavity 611, and a central axis of the second through hole 612 is parallel to a central axis of the third cavity 631.

Optionally, the third rotating shaft 62 is provided with a first through hole 622 communicating with the second cavity 621, and the first cavity 611 communicates with the second cavity 621 through the first through hole 622.

Optionally, the third rotating shaft 62 may be connected to the first flange 63 through a locking member (such as a bolt), or based on actual requirements, the third rotating shaft 62 may be connected to the first flange 63 through clamping or in another manner.

Optionally, there is an included angle between a center line of the second cavity 621 and a center line of the third cavity 631. Optionally, in this embodiment of the present application, there is an included angle of 90° between the center line of the second cavity 621 and the center line of the third cavity 631. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the included angle between the center line of the second cavity 621 and the center line of the third cavity 631 may be set to a different angle, such as 80° or 100° .

Optionally, as shown in FIG. 22, in this embodiment of the present application, the third rotary joint 60 further includes a third bearing 64 arranged between the third rotating sleeve 61 and the third rotating shaft 62, and the third rotating sleeve 61 is pivotally connected to the third rotating shaft 62 through the third bearing 64, so that the third rotating sleeve 61 and the third rotating shaft 62 can rotate relative to each other.

Optionally, as shown in FIG. 22, in this embodiment of the present application, the third rotary joint 60 further includes a third sealing member 65 arranged between the third rotating sleeve 61 and the third rotating shaft 62. The third sealing member 65 has a function the same as that of the first sealing member 44 arranged between the first rotating sleeve 41 and the first rotating shaft 42. Details are not described herein again. Optionally, the third sealing member 65 may be a framework oil seal.

Optionally, as shown in FIG. 22, in this embodiment of the present application, an end of the third rotating shaft 62 away from the first flange 63 is provided with an end cover 623, and the third rotating sleeve 61 is arranged between the end cover 623 and the first flange 63. The end cover 623 and the first flange 63 can limit the movement of the third rotating sleeve 61 in a direction of a rotation axis of the third rotating sleeve 61 and the third rotating shaft 62, thereby ensuring connection stability between the third rotating sleeve 61 and the third rotating shaft 62.

In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, a third fastener may be arranged between the third rotating sleeve 61 and the third rotating shaft 62. The third fastener has a function the same as that of the first fastener 45 arranged between the first rotating sleeve 41 and the first rotating shaft 42. Details are not described herein again. Optionally, the third fastener may be a snap spring.

Optionally, as shown in FIG. 22, in this embodiment of the present application, the mechanical arm device further includes a fifth pipe joint 95 connected to the third rotating sleeve 61, the fifth pipe joint 95 communicates with the first cavity 611, the outermost material feeding pipe 314 at the downstream position is connected to the fifth pipe joint 95, and the outermost material feeding pipe 314 at the downstream position is connected to the third rotating sleeve 61 through the fifth pipe joint 95.

Optionally, the manner of connection between the fifth pipe joint 95 and the third rotating sleeve 61 may be the same as that between the first pipe joint 91 and the end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412, and the manner of connection between the fifth pipe joint 95 and the outermost material feeding pipe 314 at the downstream position may be the same as that between the first pipe joint 91 and the outermost material feeding pipe 311 at the upstream position. Details are not described herein again.

Optionally, an inner wall of an outlet end of the third cavity 631 of the first flange 63 is provided with a second internal thread, the mixing component is provided with a second external thread matching the second internal thread, and the first flange 63 is in threaded connection with the mixing component. Optionally, as shown in FIG. 5, the mechanical arm device further includes a discharge pipe 96 connected to the mixing component, an end of the discharge pipe 96 away from the mixing component is connected to the first flange 63, and the outermost material feeding pipe 314 at the

downstream position conveys the materials to the mixing component through the third rotary joint 60 and the discharge pipe 96.

Optionally, an end of the discharge pipe 96 connected to the first flange 63 is provided with a second external thread matching the second internal thread, and the discharge pipe 96 is in threaded connection with the first flange 63. In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the mechanical arm device further includes a sixth pipe joint connected to the first flange 63, and the discharge pipe 96 communicates with the third cavity 631 of the first flange 63 through the sixth pipe joint. The manner of connection between the sixth pipe joint and the first flange 63 may be the same as that between the first pipe joint 91 and the end of the first channel 411 of the first rotating sleeve 41 away from the third channel 412, and the manner of connection between the sixth pipe joint and the discharge pipe 96 may be the same as that between the first pipe joint 91 and the outermost material feeding pipe 311 at the upstream position. Details are not described herein again.

Optionally, the mixing component is connected to the first flange 63. Optionally, the mixing component is connected to the first flange 63 through a locking member (such as a bolt). In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the mixing component may be connected to the first flange 63 through clamping or in another manner.

Optionally, in this embodiment of the present application, the mechanical arm device further includes a first driving portion 100 (refer to FIG. 3) arranged at an end of the mechanical arm 20 away from the base 10, and the first driving portion 100 is configured to drive the third rotating shaft 62 to rotate relative to the third rotating sleeve 61.

In the foregoing arrangement, driven by the first driving portion 100, the third rotating shaft 62 and the first flange 63 connected to the third rotating shaft 62 rotate relative to the third rotating sleeve 61, so that the discharge pipe 96 connected to the first flange 63 and the mixing component rotate with the first flange 63 relative to the third rotating sleeve 61, which can increase the operation range and improve flexibility and adaptability of the mixing component.

Optionally, as shown in FIG. 5 and FIG. 22, the mechanical arm device further includes a second flange 66 connected to a power output end of the first driving portion 100, and the second flange 66

is connected to an end of the third rotating shaft 62 away from the first flange 63. The first driving portion 100 drives the second flange 66 to rotate, and the third rotating shaft 62 and the first flange 63 are driven by the second flange 66 to rotate relative to the third rotating sleeve 61.

As shown in FIG. 1 to FIG. 10, in this embodiment of the present application, the mechanical arm device further includes a connecting assembly 70, where the connecting assembly 70 includes a hoop 71 arranged on a periphery of the mechanical arm 20 and a connecting ring 72 pivotally connected to the hoop 71, and the connecting ring 72 is connected to material feeding pipes 31 that are located at a middle position and are among the multiple material feeding pipes 31.

In the foregoing arrangement, the connecting assembly 70 is configured to connect the mechanical arm 20 to the material feeding pipe 31, so that the connecting assembly 70 connects the mechanical arm 20 to the delivery pipe assembly 30. In this way, when the mechanical arm 20 moves, the delivery pipe assembly 30 can move with the mechanical arm 20, and the synchronization of movement of the delivery pipe assembly 30 with the mechanical arm 20 is improved. The hoop 71 is pivotally connected to the connecting ring 72, so that the mechanical arm 20 is pivotally connected to the material feeding pipe 31, which improves flexibility of connection between the material feeding pipe 31 and the mechanical arm 20, can effectively avoid deformation of the material feeding pipe 31 during the movement of the mechanical arm 20, and facilitates normal supply of materials.

In an alternative embodiment not shown in the accompanying drawings of the present application, based on actual requirements, the mechanical arm device includes multiple connecting assemblies 70, multiple hoops 71 of the multiple connecting assemblies 70 are all arranged on a periphery of the mechanical arm 20, and multiple connecting rings 72 of the multiple connecting assemblies 70 are connected to multiple material feeding pipes 31 that are at a middle position and are among the multiple material feeding pipes 31, respectively.

The material feeding pipes 31 that are located at a middle position and are among the multiple material feeding pipes 31 mean material feeding pipes 31 that are located between the first material feeding pipe 311 and the last material feeding pipe 314 and that are among the multiple material feeding pipes 31 in the material feeding direction.

As shown in FIG. 10, in this embodiment of the present application, the connecting assembly 70 further includes a first connecting plate 73 pivotally connected to the hoop 71, and the connecting

ring 72 is connected to the first connecting plate 73.

In the foregoing arrangement, the hoop 71 is pivotally connected to the connecting ring 72 through the first connecting plate 73, so that flexibility of connection between the hoop 71 and the connecting ring 72 is improved, the mechanical arm 20 is flexibly connected to the material feeding pipe 31, and therefore the material feeding pipe 31 is not prone to deformation during the movement with the mechanical arm 20, thereby facilitating normal supply of materials.

Optionally, in this embodiment of the present application, the connecting assembly 70 further includes a second connecting rod 76 connected to the hoop 71, and the first connecting plate 73 is pivotally connected to the second connecting rod 76, so that the first connecting plate 73 is pivotally connected to the hoop 71.

As shown in FIG. 10, in this embodiment of the present application, the first connecting plate 73 is provided with a sliding slot 74, the connecting assembly 70 further includes a first connecting rod 75, a first end of the first connecting rod 75 is pivotally connected to the connecting ring 72, and a second end of the first connecting rod 75 is slidably arranged along the sliding slot 74.

In the foregoing arrangement, through the first connecting rod 75, the connecting ring 72 can slide along the sliding slot 74 and rotate relative to the first connecting plate 73, which improves flexibility of connection between the connecting ring 72 and the hoop 71, and makes connection between the mechanical arm 20 and the material feeding pipe 31 more flexible, so that the material feeding pipes 31 are not prone to deformation during the movement with the mechanical arm 20, thereby facilitating normal supply of materials.

Optionally, an end of the first connecting rod 75 matching the sliding slot 74 is provided with a slider, the slider is in clamped matching with the sliding slot 74, and the slider can slide along the sliding slot 74, thereby implementing slidable arrangement of the first connecting rod 75 along the sliding slot 74.

Optionally, in this embodiment of the present application, the material feeding pipes 31 are made of metal. The material feeding pipes 31 arranged in this way are not prone to deformation, and the material feeding pipes 31 can ensure normal supply of the materials.

In an alternative embodiment of the present application, the material feeding pipes 31 may be made of rigid plastic based on actual requirements. The rigid plastic herein means plastic with

relatively small compressive deformation and relatively small elastic deformation that can keep the material feeding pipes 31 in a certain shape in a material conveying process. A user may select material feeding pipes 31 made of suitable plastic based on an actual situation and actual requirements (e.g., considering a type and quantity of conveyed materials).

5 Optionally, in this embodiment of the present application, the mechanical arm device further includes a second driving portion configured to drive the mechanical arm 20 to rotate relative to the base 10. The second driving portion drives the mechanical arm 20, so that the mechanical arm 20 can rotate relative to the base 10, and therefore the mechanical arm 20 drives the mixing component arranged at the end of the mechanical arm 20 away from the base 10 to move flexibly, thereby
10 increasing the operation range. Optionally, the second driving portion may be a motor.

 In a floor paint coating robot, a dynamic mixer is required to mix and discharge components A and B of epoxy floor paint at a tail end of a mechanical arm. The components A and B need to be uniformly mixed at a fixed ratio before the epoxy floor paint can be used normally, otherwise the epoxy floor paint cannot solidify. Generally, the mixing ratio of the components A and B of the epoxy
15 floor paint is (5:1)–(3:1). A conventional coating robot uses two hoses for feeding. Because of high viscosity and a large flow rate of the component A, a thicker hose is required, while a thinner hose is used for the component B. Because the dynamic mixer is fixed to the tail end of the mechanical arm, when the mechanical arm moves, the hoses are prone to deformation, and the deformation of the thick and thin hoses is different, which changes the feeding ratio at the tail end and directly affects
20 solidification of an epoxy resin. In addition, under a certain operation pressure, the expansion deformation of hoses with different thicknesses is also different, which also changes the feeding ratio, further affecting the solidification of the epoxy resin.

 In view of the foregoing problem, the present application and an embodiment of the present application provide a coating robot.

25 As shown in FIG. 1 to FIG. 9, in this embodiment of the present application, the coating robot includes a mixer 80 and the foregoing mechanical arm device, where an outermost material feeding pipe 314 at a downstream position communicates with the mixer 80, and the mixer 80 forms the foregoing mixing component.

 In the foregoing arrangement, the mixer 80 is configured to mix materials, and the material

feeding pipe 31 of the mechanical arm device communicates with the mixer 80 to supply the materials to the mixer 80.

Because the coating robot according to the present application includes the mechanical arm device according to the present application, the coating robot according to the present application also has the foregoing advantages of the mechanical arm device according to the present application. Details are not described herein again.

Optionally, the mixer 80 may be a dynamic mixer, or based on actual requirements, the mixer 80 may be a static mixer, or another device capable of mixing materials. Any device that can be used to mix materials in related technologies may be used as the mixer 80 in the present application and the embodiment of the present application.

In this embodiment of the present application, the mechanical arm device includes a mechanical arm 20 (or another multi-degree-of-freedom motion mechanism), rigid material feeding pipes 31, rotary joints (first rotary joints 40, second rotary joints 50, and third rotary joints 60), a dynamic mixer 80, and a pipeline support 11.

When the mechanical arm device is in use, referring to FIG. 3, paint flows in from the first rotary joint 40, sequentially passes through the first material feeding pipe 311, the second rotary joint 50, the second material feeding pipe 312, the first rotary joint 40, an intermediate material feeding pipe 313, the second rotary joint 50, the last material feeding pipe 314, and the third rotary joint 60, and finally flows into the dynamic mixer 80.

In a paint flow direction, a first rotating shaft 42 of the 1st first rotary joint 40 connected to a base 10 is parallel to a first axis of the base 10, and a second rotating shaft 52 of the first second rotary joint 50 connected to the outermost material feeding pipe 311 at the upstream position is parallel to a second axis of rotation of the mechanical arm 20 relative to the base 10, and is perpendicular to the first axis; a first rotating shaft 42 of the second first rotary joint 40 and a second rotating shaft 52 of the 2nd second rotary joint 50 are parallel to the second rotating shaft 52 of the first second rotary joint 50; and a third rotating shaft 62 of the third rotary joint 60 is parallel to the first rotating shaft 42 of the 1st first rotary joint 40. The delivery pipe assembly 30 moves in four degrees of freedom in space.

The pipeline support 11 is fixedly connected to the base 10, and the 1st first rotary joint 40 is

connected to the base 10 through the pipeline support 11. The pipeline support 11 can prevent the delivery pipe assembly 30 from interfering with the mechanical arm 20. The pipeline support 11 is machined by using a sheet metal process. A group of connecting assemblies 70 are arranged between the material feeding pipe 31 and one arm body 21 of the mechanical arm 20. The material feeding pipe 31 is connected and fixed to the mechanical arm 20 through the connecting assemblies 70. Through a second connecting rod 76 and a sliding slot 74 of the connecting assembly 70, two-degree-of-freedom movement of the material feeding pipe 31 in a certain direction relative to the arm body 21 can be implemented. The connecting assembly 70 is configured to fix the mechanical arm 20 and the rigid material feeding pipe 31, and enable the material feeding pipe 31 to have certain activity space (as shown in FIG. 10).

In this embodiment of the present application, there are three types of rotary joints, i.e., a first rotary joint 40, a second rotary joint 50, and a third rotary joint 60. The three types of rotary joints have a core technical feature that when the three types of rotary joints rotate, internal volumes thereof do not change, so that the flow rate of the paint does not change, thereby avoiding a change in mixing ratio of the components of the mixture in the dynamic mixer.

An upper end of the third rotary joint 60 is connected to a second flange 66, and a lower end of the third rotary joint 60 includes a first flange 63 connected to the third rotating shaft 62. A first driving portion 100 transmits power to the third rotating shaft 62 through the second flange 66, thereby transmitting the rotary motion of the second flange 66 to the first flange 63. Because the mixer 80 is connected to the first flange 63, the mixer 80 can be driven to rotate, and the material feeding pipe 31 is connected to the third rotating sleeve 61, so that mutual interference between the delivery pipe assembly 30 and the mechanical arm 20 can be avoided, and the rigid material feeding pipe 31 does not affect installation and use of other mechanisms. When the third rotary joint 60 is in use, the paint enters a first cavity 611 from a fifth joint 95 connected to the third rotating sleeve 61, flows into a third cavity 631 of the first flange 63 through a first through hole 622 in the third rotating shaft 62, and flows out through a discharge port of the first flange 63.

The third rotating sleeve 61 is provided with two groups of third bearings 64 and third sealing members 65. The third bearings 64 and the third sealing members 65 are arranged at an upper end and a lower end of the third rotating sleeve 61 respectively. The third sealing members 65 are

arranged on an inner side of the third rotating sleeve 61 and the third bearings 64 are arranged on an outer side of the third rotating sleeve 61. Through the foregoing arrangement, dynamic sealing is implemented, the third bearings 64 provide a sufficient supporting force, and the third sealing members 65 implement sealing, so that rotary dynamic sealing of the third rotating sleeve 61 can be implemented, and the rigid material feeding pipe 31 can be supported and fixed, thereby fixing the material feeding pipe 31 to the mechanical arm 20.

The third rotating sleeve 61 is connected to the fifth pipe joint 95 through a bolt, and a fluororubber O-ring is provided between the third rotating sleeve 61 and the fifth pipe joint 95 for sealing and has an anti-corrosion effect.

When the second rotary joint 50 is in use, the paint flows in from the lower second rotating shaft 52 and passes across the second rotating sleeve 51, the flow direction of the paint is turned by 90°C, and then the paint flows out through the third pipe joint 93. A lower end of the second rotating shaft 52 is threaded, and the third pipe joint 93 is also threaded. Both the second rotating shaft 52 and the third pipe joint 93 are connected to the material feeding pipe 31 through threaded connection. The third pipe joint 93 is connected to the second rotating sleeve 51 through a bolt, and an O-ring seal is arranged between the third pipe joint 93 and the second rotating sleeve 51 for sealing and has an anti-corrosion effect. Two second bearings 53 are installed between the second rotating shaft 52 and the second rotating sleeve 51 to provide axial and normal fixation. A second sealing member 54 is further installed between the second rotating shaft 52 and the second rotating sleeve 51 to provide rotary sealing, and a second fastener 55 is configured to fix the position of the second bearings 53. The second rotating shaft 52 and the second rotating sleeve 51 can freely rotate by 360°C. A third flow channel 512 of the second rotating shaft 52 has a diameter equal to that of a fourth flow channel 522 of the second rotating sleeve 51, and the diameter is set to make the paint flow smoothly and reduce flow resistance. A first flow channel 511 of the second rotating sleeve 51 is formed by connecting two drilled holes, and a certain process corner is provided at the bottom of the drilled hole. A commonly used drilling tool has a drilling angle of 118°C, and this process corner can provide a chamfer, which makes the materials flow more smoothly.

When the first rotary joint 40 is in use, the paint flows in from the second pipe joint 92, passes across the first rotating shaft 42 and the first rotating sleeve 41, and finally flows out through the first

pipe joint 91. Functions of an O-ring between the first pipe joint 91 and the first rotating shaft 42 and an O-ring between the second pipe joint 92 and the first rotating sleeve 41 are the same as above, and functions of the first bearing 43 and the first sealing member 44 are the same as above. Similarly, a fourth channel 422 of the first rotating shaft 42 has a diameter equal to that of a third channel 412 of the first rotating sleeve 41, which can make the paint flow smoothly and reduce flow resistance. The first rotary joint 40 enables two parallel material feeding pipes 31 to freely rotate by 360°C.

The dynamic mixer 80 can uniformly mix the paint with the component A and the component B in a mixing chamber, and the uniform mixing is implemented through stirring by using a motor.

In this embodiment of the present application, the component A in the dynamic mixer 80 is supplied through a rigid material feeding pipe 31, an inlet of the component A in the dynamic mixer 80 is connected to the third rotary joint 60 through the outermost material feeding pipe 31 at the downstream position, and the component B is directly supplied through a thin hose. Due to a large flow rate and high viscosity of the component A, a larger pipeline is required for direct supply, and the rigid material feeding pipe 31 has an inner diameter of 20 mm. The component B has a small flow rate and low viscosity, and thus a hose with an inner diameter of 4–10 mm is used. Because of the smaller diameter, when the mechanical arm moves and the pipeline is under pressure, the deformation of the hose is smaller, and may be neglected. Through the feeding manner using the large-diameter rigid delivery pipe assembly 30 combined with the small-diameter hose, the dynamic mixer 80 can accurately mix the components A and B in proportion, thereby resolving the problems that an epoxy resin does not solidify or solidifies excessively fast or excessively slowly due to a mixing ratio error.

In the mechanical arm device and the coating robot according to embodiments of the present application:

1. Through the replacement of a thick hose as the material feeding pipe 31 with a rigid pipeline and the pivotal connection of two adjacent material feeding pipes 31 through a rotary joint, the problem of deformation of the material feeding pipe 31 caused by movement and pressure can be resolved, and requirements of the mixer for the ratio of the components of the mixture can be met.

2. Three types of rotary joints (the first rotary joint 40, the second rotary joint 50, and the third rotary joint 60) are provided. In the mechanical arm device in the embodiment of the present

application, five rotary joints are used in total, so that the rigid material feeding pipe 31 has four degrees of freedom, and therefore the delivery pipe assembly 30 can move freely with the mechanical arm 20.

3. The first rotary joint 40, the second rotary joint 50, and the third rotary joint 60 are all pivotally connected by bearings and sealed by the framework oil seal structure, and have good sealing performance and long service lives.

From the foregoing description, it can be learned that the mechanical arm 20 and the delivery pipe assembly 30 according to the present application are both configured to be rotatable relative to the base 10, and both the mechanical arm 20 and the delivery pipe assembly 30 are connected to the mixing component (i.e., the dynamic mixer 80). Therefore, when the mechanical arm 20 rotates relative to the base 10, the delivery pipe assembly 30 can rotate with the mechanical arm 20 relative to the base 10. In addition, because multiple material feeding pipes 31 of the delivery pipe assembly 30 are pivotally connected in sequence, the delivery pipe assembly 30 can adapt to the movement of the mechanical arm 20, so that the delivery pipe assembly 30 moves synchronously with the mechanical arm 20, thereby avoiding deformation of the material feeding pipes 31 during the movement of the mechanical arm 20, and ensuring normal supply of materials. The movement of the mechanical arm 20 can drive the mixing component to move, so that the position of the mixing component changes, and adaptability of the mechanical arm device and the mixing component is improved. The multiple material feeding pipes 31 are pivotally connected in sequence, and internal cavities of two adjacent material feeding pipes 31 communicate with each other, so that the delivery pipe assembly 30 can adapt to the movement of the mechanical arm 20, deformation of the material feeding pipes 31 is avoided, and the materials are conveyed to the mixing component, thereby ensuring normal supply of the materials.

For example, an embodiment provides a mixer 80, which is a dynamic mixer 80, and is configured to stir two fluids. In this embodiment, the component A is introduced into a mixing pipe through a first flow passage, the component B is introduced into the mixing pipe through a second flow passage, and an example in which the component A and the component B in the mixing pipe are mixed is taken for description. The component A and the component B will solidify after coming into contact with each other. In another embodiment, the component B may be introduced into the

first flow passage, and the component A may be introduced into the second flow passage. This is not limited herein.

As shown in FIG. 27 to FIG. 29, the dynamic mixer 80 includes a supporting body 81, a mixing pipe 82, and a stirring assembly 83. The mixing pipe 82 is connected to the supporting body 81. The dynamic mixer 80 further includes a first flow passage 811 and a second flow passage 812, where the first flow passage 811 communicates with the mixing pipe 82, and the second flow passage 812 communicates with the mixing pipe 82. A first end of the stirring assembly 83 is rotatably supported on the supporting body 1, and a second end thereof passes through the first flow passage 811 and extends into the mixing pipe 82.

In the dynamic mixer 80 of the present application, the stirring assembly 83 passes through the first flow passage 811 and then enters the mixing pipe 82. Therefore, after the component A is introduced into the first flow passage 811 and the component B is introduced into the second flow passage 812, the component A in the first flow passage 811 can isolate the component B in the second flow passage 812 and the mixing pipe 82 from a rotation clearance between the stirring assembly 83 and the supporting body 81, i.e., the component A and the component B cannot be in contact with the rotation clearance between the stirring assembly 83 and the supporting body 81 simultaneously, thereby avoiding bonding between the stirring assembly 83 and the supporting body 81, and ensuring normal use of the dynamic mixer 80.

In this embodiment, the mixing pipe 82 is connected to a lower end of the supporting body 81, and an outlet of the mixing pipe 82 is arranged at the bottom of the mixing pipe 82 to facilitate discharging.

Optionally, the first flow passage 811 and the second flow passage 812 are separately provided on the supporting body 81. Therefore, parts of the dynamic mixer 80 can be reduced, manufacturing costs can be reduced, and the structure of the dynamic mixer 80 can be more compact. In another embodiment, another component may be provided between the supporting body 81 and the mixing pipe 82, and the first flow passage 811 and the second flow passage 812 may be formed in the component.

Optionally, as shown in FIG. 28, the first flow passage 811 includes a first opening 8111 and a second opening 8112, where the first end of the stirring assembly 83 passes through the first opening

8111 and is rotatably connected to the supporting body 81, and the second end thereof passes through the second opening 8112 and extends into the mixing pipe 82, so as to stir the component A and the component B in the mixing pipe 82.

For example, the first flow passage 811 further includes a third opening 8113, and the third opening 8113 is provided to introduce a fluid into the first flow passage 811. An inlet of the component A is separated from the first opening 8111, so that it is more convenient to connect an apparatus for storing the component A to the first flow passage 811. In this embodiment, an axis of the third opening 8113 is perpendicular to an axis of the first opening 8111, so that the first opening 8111 and the third opening 8113 communicate with the outside of the supporting body 81 from different sides of the supporting body 81, making the layout more reasonable, and improving convenience of connecting the apparatus for storing the component A to the first flow passage 811.

Optionally, as shown in FIG. 28, the stirring assembly 83 includes a rotating shaft 831 and a stirring member 832, where a first end of the rotating shaft 831 rotatably matches the supporting body 81, and a second end thereof extends into the first flow passage 811. An end of the stirring member 832 is connected to the second end of the rotating shaft 831 extending into the first flow passage 811. The rotating shaft 831 is rotatably connected to the supporting body 81. The stirring member 32 is configured to stir the fluid in the mixing pipe 82, so as to ensure a good stirring effect. Optionally, the stirring member 832 may be a stirring shaft with blades spaced along its own axial direction or a stirring shaft with a spiral belt arranged along its own axial direction, as long as the stirring member 832 is a component that can achieve a stirring function during rotation around its own axial direction.

For example, as shown in FIG. 28, the stirring assembly 83 further includes a U-shaped buckle 833, the U-shaped buckle 833 is connected to the second end of the rotating shaft 831 extending into the first flow passage 11, and the stirring member 832 is fixed in a groove of the U-shaped buckle 833 by using a fastener. On the one hand, the fastener penetrates through the U-shaped buckle 833 and an end portion of the stirring member 832 to implement connection, which makes the structure simple and makes the operation easy; on the other hand, a groove wall of the U-shaped buckle 833 can serve a certain function of supporting a side wall of the end portion of the stirring member 832, so as to prevent the stirring member 832 from swinging greatly due to the resistance in mixing the

components, and ensure connection firmness between the rotating shaft 831 and the stirring member 832. In this embodiment, the fastener may be a bolt or a pin.

Optionally, as shown in FIG. 28, the dynamic mixer 80 further includes a first bearing 85, the first bearing 85 is connected to the supporting body 81, and the first end of the stirring assembly 83 is connected to an inner ring of the first bearing 85, thereby implementing rotatable matching between the stirring assembly 83 and the supporting body 81. In this embodiment, the rotating shaft 831 of the stirring assembly 83 is connected to the first bearing 85. For example, the first bearing 85 is arranged outside the first flow passage 811, so that the component A can be prevented from being immersed in the first bearing 85, and normal rotation of the rotating shaft 831 is ensured. Optionally, the first bearing 85 is arranged on an upper end face of the supporting body 81.

Optionally, as shown in FIG. 28, the dynamic mixer 80 further includes a framework oil seal 84, the framework oil seal 84 is connected to the supporting body 81 and arranged at the first opening 8111, and the stirring assembly 83 rotationally matches the framework oil seal 84. The framework oil seal 84 can seal the first flow passage 811, prevent the component A from flowing out of the first flow passage 811, and can also ensure that the stirring assembly 83 is not bonded to the supporting body 81. In this embodiment, the rotating shaft 831 rotatably matches the framework oil seal 84, and the framework oil seal 84 is located between the first opening 8111 and the first bearing 85, so that the framework oil seal 84 can also prevent the component A from flowing into the first bearing 85, thereby ensuring normal operation of the first bearing 85. The framework oil seal 84 is an element mature in related technologies, and a specific specification and type thereof may be selected based on actual requirements.

For example, as shown in FIG. 28, the dynamic mixer 80 includes multiple framework oil seals 84, and the multiple framework oil seals 84 are sequentially arranged in an axial direction of the stirring assembly 83. The multiple framework oil seals 84 can improve airtightness of the first flow passage 811 and ensure that the component A does not leak out.

Optionally, an inlet of the first flow passage 811 is provided with a first check valve, and the first check valve only allows a fluid to flow into the first flow passage 811 in a unidirectional direction, thereby avoiding backflow of the component A in the first flow passage 811. An inlet of the second flow passage 812 is provided with a second check valve, and the second check valve only

allows a fluid to flow into the second flow passage 812 in a unidirectional direction, thereby avoiding backflow of the component B in the second flow passage 812.

Optionally, as shown in FIG. 28 and FIG. 29, the dynamic mixer 80 further includes a fixing cylinder 86, and the fixing cylinder 86 is sleeved outside the mixing pipe 82 and connected to the supporting body 81, so that the mixing pipe 82 is connected to the supporting body 81. The fixing cylinder 86 connects the mixing pipe 82 to the supporting body 81, which can reduce machining difficulty of the mixing pipe 82, make the structure simple, and make the operation easy.

For example, as shown in FIG. 28, the fixing cylinder 86 includes a supporting portion 861, the supporting portion 861 is arranged at an end away from the supporting body 81, and the supporting portion 861 has a length not less than 1/2 that of the mixing pipe 82, so that the supporting portion 861 covers at least half of the area of the mixing pipe 82. This can serve a very good function of limiting and supporting the mixing pipe 82, reduce shaking of the mixing pipe 82 during mixing and stirring, and improve operation stability of the dynamic mixer 80. In this embodiment, an inner wall of the supporting portion 861 is attached to an outer surface of the mixing pipe 82 to effectively support and limit the mixing pipe 82.

Optionally, as shown in FIG. 29, an end of the mixing pipe 82 close to the supporting body 81 is provided with a tapered abutting portion 821, a middle portion of the fixing cylinder 86 is provided with a bearing portion 862 with a same taper as the abutting portion 821, and the abutting portion 821 abuts against the bearing portion 862. Under the action of gravity, the tapered abutting portion 821 can be well attached to the bearing portion 862, so that the fixing cylinder 86 stably supports the mixing pipe 82, and the problem that the abutting portion 821 and the bearing portion 862 cannot precisely match each other due to factors such as a machining error can be resolved.

For example, as shown in FIG. 29, an end of the fixing cylinder 86 close to the supporting body 81 is provided with a connecting portion 863, and the connecting portion 863 is in threaded connection with the supporting body 81. The manner of threaded connection makes the structure simple and makes the operation easy. In this embodiment, the connecting portion 863 is provided with an internal thread, a lower end of the supporting body 81 is provided with an external thread, and the connecting portion 863 is sleeved at the lower end of the supporting body 81 to implement threaded connection.

Optionally, as shown in FIG. 29, the dynamic mixer 80 further includes a sealing ring 87, and the sealing ring 87 is arranged on an end portion of the mixing pipe 82 and located between the fixing cylinder 86 and the supporting body 81. The sealing ring 87 can ensure airtightness of the mixing pipe 82, prevent a liquid from overflowing from a joint of the mixing pipe 82 and the supporting body 81, and avoid a material loss. In this embodiment, the sealing ring 87 may be a rubber ring, which has good sealing performance and low costs.

Optionally, as shown in FIG. 27 and FIG. 28, the dynamic mixer 80 further includes a driving assembly 88, the driving assembly 88 is connected to the supporting body 81 and arranged side by side with the mixing pipe 82, and the driving assembly 88 is capable of driving the stirring assembly 83 to rotate. The side-by-side arrangement means that an output shaft of the driving assembly 88 is arranged on a side of the mixing pipe 82 and is parallel or nearly parallel to the stirring assembly 83. The arrangement of the driving assembly 88 on the side of the supporting body 81 can reduce a dimension of the entire dynamic mixer 80 in the axial direction of the rotating shaft 831, and the structure of the dynamic mixer 80 in the axial direction of the rotating shaft 831 is more compact, so as to make rational use of space. In this embodiment, the driving assembly 88 may be a rotary motor or another component or assembly capable of outputting rotary motion. This is not specifically limited herein.

For example, as shown in FIG. 27 and FIG. 28, the dynamic mixer 80 further includes a transmission assembly 89, a first end of the transmission assembly 89 is connected to the first end of the stirring assembly 83, and a second end thereof is connected to an output end of the driving assembly 88, so as to implement power transmission between the driving assembly 88 and the stirring assembly 83 arranged side by side. In this embodiment, the transmission assembly 89 includes a driving gear 891 and a driven gear 892, where the driving gear 891 is connected to the output end of the driving assembly 88, the driven gear 892 is connected to the rotating shaft 831 of the stirring assembly 83, and the driving gear 891 meshes with the driven gear 892. The manner of gear transmission is high in precision and makes the service life long. Optionally, the transmission assembly 89 further includes an intermediate gear 893, a second bearing 894, and a connecting shaft 895, where the second bearing 894 is arranged on the supporting body 81, the connecting shaft 895 is connected to an inner ring of the second bearing 894, and the intermediate gear 893 is arranged on

the connecting shaft 895 and meshes with the driving gear 891 and the driven gear 892. When there is a relatively large shaft distance between the rotating shaft 831 and the output shaft of the driving assembly 88, through the arrangement of the intermediate gear 893, it is unnecessary to increase diameters of the driving gear 891 and the driven gear 892, which ensures structural compactness of the dynamic mixer 80.

In other embodiments (not shown), the transmission assembly 89 includes a driving pulley, a driven pulley, and a belt, where the driving pulley is connected to the output end of the driving assembly 88, the driven pulley is connected to the first end (i.e., the rotating shaft 831) of the stirring assembly 83, and the belt is wound around the driving pulley and the driven pulley. The belt transmission structure is simple and the transmission is stable. The forms of the transmission assembly 89 are not limited to the above, and a person skilled in the art can also choose other transmission manners based on requirements. This is not limited herein.

In the foregoing dynamic mixer 80, the stirring assembly 83 passes through the first flow passage 811 and then enters the mixing pipe 82. Therefore, a fluid in the first flow passage 811 can isolate another fluid in the second flow passage 812 and the mixing pipe 82 from a rotation clearance between the stirring assembly 83 and the supporting body 81, i.e., the two fluids cannot be in contact with the rotation clearance between the stirring assembly 83 and the supporting body 81 simultaneously, thereby avoiding bonding between the stirring assembly 83 and the supporting body 81, and ensuring normal use of the dynamic mixer 80.

It should be noted that the terms used herein are only for describing specific implementations, and are not intended to limit the example implementations according to the present application. As used herein, the singular form is also intended to include the plural form unless the context clearly indicates otherwise. In addition, it should be further understood that when the terms "comprising" and/or "including" are used in this specification, they indicate the presence of features, steps, operations, devices, assemblies and/or a combination thereof.

It should be noted that the terms such as "first" and "second" in the specification and claims of the present application and the foregoing accompanying drawings are used to distinguish between similar objects and are not necessarily used to describe a specific order or sequence. It should be understood that data used in such a way may be interchanged under appropriate circumstances such

that the implementations of the present application described herein can be implemented in an order other than those illustrated or described herein.

CLAIMS

1. A mechanical arm device, comprising:

a base (10);

5 a mechanical arm (20) connected to the base (10) and configured to be rotatable relative to the base (10); and

a delivery pipe assembly (30) arranged on the mechanical arm (20), wherein the delivery pipe assembly (30) is configured to be rotatable relative to the base (10), and at least a portion of the delivery pipe assembly (30) moves synchronously with the mechanical arm (20); wherein

10 the delivery pipe assembly (30) comprises multiple material feeding pipes (31) pivotally connected in sequence, and internal cavities of two adjacent material feeding pipes (31) communicate with each other.

2. The mechanical arm device according to claim 1, wherein a central axis of rotation of the delivery pipe assembly (30) relative to the base (10) is parallel to a central axis of rotation of the mechanical arm (20) relative to the base (10), so that the delivery pipe assembly (30) and the
15 mechanical arm (20) have a same movement trend.

3. The mechanical arm device according to claim 1, wherein a first end of the mechanical arm (20) is connected to the base (10), and a second end of the mechanical arm (20) is connected to a mixing component; in a material feeding direction, the first material feeding pipe (311) among the multiple material feeding pipes (31) is arranged on the base (10) and connected to a feeding
20 component, and the last material feeding pipe (314) among the multiple material feeding pipes (31) is connected to the mixing component.

4. The mechanical arm device according to claim 1, wherein the mechanical arm (20) comprises multiple arm bodies (21) that are sequentially connected to each other, two adjacent arm bodies (21) are pivotally connected to each other, and the multiple arm bodies (21) are arranged corresponding
25 to the multiple material feeding pipes (31) respectively.

5. The mechanical arm device according to claim 1, wherein

the delivery pipe assembly (30) and the mechanical arm (20) are arranged in a front-rear direction; or

among the multiple material feeding pipes (31), the first material feeding pipe (311) and the last material feeding pipe (314) in the material feeding direction are arranged in the front-rear direction, and material feeding pipes (31) located between the first material feeding pipe (311) and the last material feeding pipe (314) are arranged in a left-right direction.

5 6. The mechanical arm device according to claim 2, further comprising a rotary connector, wherein the delivery pipe assembly (30) is pivotally connected to the base (10) through the rotary connector.

7. The mechanical arm device according to claim 6, wherein the mechanical arm (20) is rotatably arranged around a first axis of the base (10), the rotary connector comprises a first rotary joint (40), the first material feeding pipe (311) among the multiple material feeding pipes (31) in the material feeding direction is pivotally connected to the base (10) through the first rotary joint (40), and a central axis of rotation of the first material feeding pipe (311) relative to the base (10) is parallel to the first axis.

8. The mechanical arm device according to claim 7, wherein the first rotary joint (40) comprises:
15 a first rotating sleeve (41) with a first channel (411); and
 a first rotating shaft (42) pivotally connected to the first rotating sleeve (41), wherein the first rotating shaft (42) is provided with a second channel (421) communicating with the first channel (411), a center line of the first channel (411) is parallel to a center line of the second channel (421), and the first material feeding pipe (311) among the multiple material feeding pipes (31) in the material feeding direction communicates with the feeding component through the first channel (411) and the second channel (421).

9. The mechanical arm device according to claim 7, wherein the mechanical arm (20) is rotatably arranged around a second axis of the base (10), the first axis is perpendicular to the second axis, the rotary connector further comprises a second rotary joint (50), the first material feeding pipe (311) among the multiple material feeding pipes (31) in the material feeding direction is pivotally connected to the second material feeding pipe (312) adjacent to the first material feeding pipe (311) through the second rotary joint (50), and a central axis of rotation of the second material feeding pipe (312) relative to the first material feeding pipe (311) through the second rotary joint (50) is parallel to the second axis.

10. The mechanical arm device according to claim 9, wherein the second rotary joint (50) comprises:

a second rotating sleeve (51) with a first flow channel (511); and

a second rotating shaft (52) pivotally connected to the second rotating sleeve (51), wherein the
 5 second rotating shaft (52) is provided with a second flow channel (521) communicating with the first flow channel (511), and a center line of the first flow channel (511) is perpendicular to a center line of the second flow channel (521); in the material feeding direction, the first material feeding pipe (311) among the multiple material feeding pipes (31) communicates with the second flow channel (521), and the second material feeding pipe (312) adjacent to the first material feeding pipe (311)
 10 communicates with the first flow channel (511).

11. The mechanical arm device according to claim 3, further comprising a third rotary joint (60) and a first driving portion (100), wherein in the material feeding direction, the last material feeding pipe (314) among the multiple material feeding pipes (31) communicates with the mixing component through the third rotary joint (60), the third rotary joint (60) comprises a third rotating shaft (62), the
 15 first driving portion (100) is configured to drive the third rotating shaft (62) to rotate, and the first driving portion (100) is arranged at an end of the mechanical arm (20) away from the base (10); or
 the material feeding pipes (31) are made of metal or rigid plastic.

12. The mechanical arm device according to any one of claims 1 to 10, further comprising a connecting assembly (70), wherein the connecting assembly (70) comprises a hoop (71) arranged on
 20 a periphery of the mechanical arm (20) and a connecting ring (72) pivotally connected to the hoop (71), and the connecting ring (72) is connected to material feeding pipes (31) that are located between the first material feeding pipe (311) and the last material feeding pipe (314) and are among the multiple material feeding pipes (31) in the material feeding direction.

13. The mechanical arm device according to claim 12, wherein the connecting assembly (70)
 25 further comprises a first connecting plate (73) pivotally connected to the hoop (71), and the connecting ring (72) is connected to the first connecting plate (73).

14. The mechanical arm device according to claim 13, wherein the first connecting plate (73) is provided with a sliding slot (74), the connecting assembly (70) further comprises a first connecting

rod (75), a first end of the first connecting rod (75) is pivotally connected to the connecting ring (72), and a second end of the first connecting rod (75) is slidably arranged along the sliding slot (74).

15. A coating robot, comprising a mixer (80) and the mechanical arm device according to any one of claims 1 to 14, wherein the last material feeding pipe (314) among multiple material feeding
5 pipes (31) in a material feeding direction communicates with the mixer (80), and the mixer (80) forms a mixing component.

16. The coating robot according to claim 15, wherein the mixer (80) comprises:

a supporting body (81), a mixing pipe (82), and a stirring assembly (83), wherein the supporting
body (81) is connected to the mixing pipe (82);

10 a first flow passage (811) communicating with the mixing pipe (82); and

a second flow passage (812) communicating with the mixing pipe (82), wherein

a first end of the stirring assembly (83) is rotatably supported on the supporting body (81), and
a second end thereof passes through the first flow passage (811) and extends into the mixing pipe
(82).

15 17. The coating robot according to claim 16, wherein the first flow passage (811) and the second
flow passage (812) are separately provided on the supporting body (81).

18. The coating robot according to claim 16 or 17, wherein the first flow passage (811)
comprises a first opening (8111) and a second opening (8112), the first end of the stirring assembly
(83) passes through the first opening (8111) and is rotatably connected to the supporting body (81),
20 and the second end of the stirring assembly (83) passes through the second opening (8112) and
extends into the mixing pipe (82).

19. The coating robot according to claim 18, wherein the first flow passage (811) further
comprises a third opening (8113), and the third opening (8113) is provided to introduce a fluid into
the first flow passage (811).

25 20. The coating robot according to claim 18, wherein the mixer (80) further comprises a
framework oil seal (84), the framework oil seal (84) is connected to the supporting body (81) and
arranged at the first opening (8111), and the stirring assembly (83) rotationally matches the
framework oil seal (84).

21. The coating robot according to claim 20, wherein the mixer (80) comprises multiple framework oil seals (84), and the multiple framework oil seals (84) are sequentially arranged in an axial direction of the stirring assembly (83).

22. The coating robot according to claim 16 or 17, wherein the mixer (80) further comprises a first bearing (85), the first bearing (85) is connected to the supporting body (81), and the first end of the stirring assembly (83) is connected to an inner ring of the first bearing (85).

23. The coating robot according to claim 16 or 17, further comprising at least one of the following features:

an inlet of the first flow passage (811) is provided with a first check valve, and the first check valve is configured to only allow a fluid to flow into the first flow passage (811) in a unidirectional direction; and

an inlet of the second flow passage (812) is provided with a second check valve, and the second check valve is configured to only allow a fluid to flow into the second flow passage (812) in a unidirectional direction.

24. The coating robot according to claim 16 or 17, wherein the stirring assembly (83) comprises: a rotating shaft (831), wherein a first end of the rotating shaft (831) rotatably matches the supporting body (81), and a second end of the rotating shaft (831) extends into the first flow passage (811); and

a stirring member (832), wherein an end of the stirring member (832) is connected to the second end of the rotating shaft (831) extending into the first flow passage (811), and the stirring member (832) is configured to stir a fluid in the mixing pipe (82).

25. The coating robot according to claim 24, wherein the stirring assembly (83) further comprises a U-shaped buckle (833), the U-shaped buckle (833) is connected to the second end of the rotating shaft (831) extending into the first flow passage (811), and the stirring member (832) is fixed in a groove of the U-shaped buckle (833) by using a fastener.

26. The coating robot according to claim 16 or 17, wherein the mixer (80) further comprises a fixing cylinder (86), and the fixing cylinder (86) is sleeved outside the mixing pipe (82) and connected to the supporting body (81), so that the mixing pipe (82) is connected to the supporting body (81).

27. The coating robot according to claim 26, wherein an end of the fixing cylinder (86) away from the supporting body (81) is provided with a supporting portion (861), and the supporting portion (861) has a length greater than or equal to $1/2$ that of the mixing pipe (82).

28. The coating robot according to claim 26, wherein an end of the mixing pipe (82) close to the supporting body (81) is provided with a tapered abutting portion (821), a middle portion of the fixing cylinder (86) is provided with a bearing portion (862) with a same taper as the abutting portion (821), and the abutting portion (821) abuts against the bearing portion (862).

29. The coating robot according to claim 26, wherein an end of the fixing cylinder (86) close to the supporting body (81) is provided with a connecting portion (863), and the connecting portion (863) is in threaded connection with the supporting body (81).

30. The coating robot according to claim 26, wherein the mixer (80) further comprises a sealing ring (87), and the sealing ring (87) is arranged on an end portion of the mixing pipe (82) and located between the fixing cylinder (86) and the supporting body (81).

31. The coating robot according to claim 16 or 17, wherein the mixer (80) further comprises a driving assembly (88), the driving assembly (88) is connected to the supporting body (81) and arranged side by side with the mixing pipe (82), and the driving assembly (88) is capable of driving the stirring assembly (83) to rotate.

32. The coating robot according to claim 31, wherein the mixer (80) further comprises a transmission assembly (89), a first end of the transmission assembly (89) is connected to the first end of the stirring assembly (83), and a second end of the transmission assembly (89) is connected to an output end of the driving assembly (88).

33. The coating robot according to claim 32, wherein the transmission assembly (89) comprises a driving gear (891) and a driven gear (892), wherein the driving gear (891) is connected to the output end of the driving assembly (88), the driven gear (892) is connected to the first end of the stirring assembly (83), and the driving gear (891) meshes with the driven gear (892); or

the transmission assembly (89) comprises a driving pulley, a driven pulley, and a belt, wherein the driving pulley is connected to the output end of the driving assembly (88), the driven pulley is connected to the first end of the stirring assembly (83), and the belt is wound around the driving pulley and the driven pulley.