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Mixing device and liquid mixing method

Abstract

The disclosure relates to a mixing device and a liquid mixing method. The mixing device comprises a first clamping assembly, a second clamping assembly and a driving assembly, the first clamping assembly is used for fixing a first container containing a first liquid, the second clamping assembly is used for fixing a second container containing a second liquid, the first container and the second container are in communication, the driving assembly drives the first liquid and the second liquid to flow back and forth between the first container and the second container to complete a predetermined degree of mixing to form a third liquid. The flow speed of the first liquid and the second liquid driven by the driving assembly is accurately controlled, so that an iodized oil emulsion with better physical and chemical characteristics is prepared, and an emulsion with better emulsifying effect and treatment effect is obtained.

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Background/Summary

RELATED APPLICATIONS (1) This application is a continuation application of PCT application No. PCT/CN2020/098507, filed on Jun. 28, 2020, which claims priority to Chinese Application No. 201910672106.9, filed on Jul. 24, 2019, and the content of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

(1) The present disclosure relates to the field of medical equipment, and particularly to a mixing device and a liquid mixing method.

BACKGROUND

(2) Transcatheter arterial chemoembolization (TACE) is the mainstay treatment for patients with Barcelona Clinic Liver Cancer (BCLC) stage B (intermediate stage). The treatment method is usually to inject a mixed emulsion of an anticancer drug and an iodized oil into tumor vessels at an appropriate rate to perform the treatment.

(3) The iodized oil emulsion needs to be freshly prepared. During an operation, the iodized oil and an aqueous solution of an anticancer drug or an iodine-containing contrast agent are fully mixed and emulsified. The conventional preparation method has the problem of a poor emulsification effect, thus affecting the treatment effect.

(4) In order to solve the aforementioned problem of poor emulsification effect, a mixing device and a liquid mixing method are needed.

SUMMARY

(5) The technical scheme of the application aims to solve the problem of poor emulsification effect. Therefore, it is necessary to provide a mixing device and a liquid mixing method. The mixing device has good emulsification effect and may be used for surgical treatment.

(6) According to a first aspect of the present disclosure, a mixing device includes a first clamping assembly configured to fix a first container to contain a first liquid; a second clamping assembly configured to fix a second container to contain a second liquid; and a driving assembly. When the mixing device is in operation, the first container is in communication with the second container, relative positions of the first clamping assembly, the second clamping assembly and the driving assembly are fixed, and the driving assembly drives the first liquid and the second liquid to flow back and forth between the first container and the second container to complete a predetermined degree of mixing so as to form a third liquid.

(7) According to a second aspect of the present application, a liquid mixing method includes filling a first container with a first liquid; filling a second container with a second liquid, the first container being in communication with the second container; and driving, by a driving assembly of a mixing device, the first liquid and the second liquid to flow back and forth between the first container and the second container to complete a predetermined degree of mixing to form a third liquid.

(8) According to the above technical scheme, the mixing device fixes the first container containing the first liquid on the first clamping assembly and fixes the second container containing the second liquid on the second clamping assembly; the mixing device also makes the first container in communication with the second container, and drives the first piston of the first container to reciprocate in the first tubular cavity through the driving assembly, thereby driving the first liquid and the second liquid to reciprocate in the first container and the second container, thereby mixing the first liquid and the second liquid.

(9) Other functions of this application will be partially listed in the following description. From the description, the following figures and examples will be apparent to those of ordinary skill in the art.

The inventive aspects of this application may be fully explained by practicing or using the methods, devices and combinations described in the following detailed examples.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) In order to explain the technical scheme in the embodiment of the application more clearly, the following will briefly introduce the drawings needed in the embodiment description. Obviously, the drawings in the following description are only some embodiments of the application. For those skilled in the art, other drawings may be obtained according to these drawings without creative labor.

(2) FIG. **1** shows a schematic structural view of a mixing device provided according to some embodiments of the present application;

(3) FIG. **2** shows a schematic structural view of a first clamping assembly in a mixing device according to some embodiments of the present application;

(4) FIG. **3** shows a schematic assembly diagram of a first clamping assembly and a second clamping assembly in a mixing device according to some embodiments of the present application; and

(5) FIG. **4** shows a flow chart of a liquid mixing method according to some embodiments of the present application.

DETAILED DESCRIPTION

(6) In order to understanding the present disclosure, the present disclosure will be described more fully below with reference to the relevant drawings. A preferred embodiment of the present disclosure is shown in the drawings. However, the present disclosure may be implemented in many different forms and is not limited to the embodiments described herein. On the contrary, these embodiments are provided for a more thorough and complete understanding of the present disclosure.

(7) It should be noted that when an element is referred to as “fixed” to another element, it may be directly on the other element or there may also be an intermediate element. When an element is considered to be “connected” to another element, it may be directly connected to the other element or there may be intermediate elements at the same time. The terms “vertical”, “horizontal”, “left”, “right” and similar expressions used herein are for illustration purposes only and are not meant to be the only embodiment.

(8) Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by those skilled in the art of the present disclosure. The terminology used in the description of the present disclosure herein is for the purpose of describing specific embodiments only and is not intended to limit the present disclosure. As used herein, the term “and/or” includes any and all combinations of one or more related listed items.

(9) FIG. **1** shows a schematic structural view of a mixing device **10** provided according to some embodiments of the present application. Referring to FIG. **1**, the mixing device **10** is used to fully mix the first fluid and the second fluid. The first fluid and the second fluid may be any gas that needs to be mixed. The first fluid and the second fluid may also be a first liquid and a second liquid, respectively. For convenience of explanation, the present disclosure will be described in the following description by taking liquid as an example.

(10) The first liquid and the second liquid may be any liquid that needs to be mixed. For example, the first liquid may be a water-based liquid and the second liquid may be an oil-based liquid; or the first liquid may be an oil-based liquid and the second liquid may be a water-based liquid. Of course, both the first liquid and the second liquid may be water-based liquids, and both the first liquid and the second liquid may be oil-based liquids. For convenience of description, the mixing

device **10** is used to mix an iodized oil, a chemotherapy drug aqueous liquid or an iodine-containing contrast agent to prepare an iodized oil emulsion, taking the formation of an emulsion that meets the requirements as an example for detailed description. Referring to FIG. **1**, the mixing device **10** may include a first clamping assembly **100**, a second clamping assembly **300**, and a driving assembly **20**. In some embodiments, the mixing device **10** may further include a control assembly **500**. In some embodiments, the mixing device **10** may further include a third clamping assembly **800** and a machine table **510**. In some embodiments, the mixing device **10** may further include a first adjusting assembly **600** and a second adjusting assembly **700**.

(11) The first clamping assembly **100** may be used to fix the first container **11**. The second clamping assembly **300** may be used to fix the second container **12**. The first container **11** may be used to contain the first liquid, and the second container **12** may be used to contain the second liquid. When the mixing device **10** is in operation, the relative positions of the first clamping assembly **100**, the second clamping assembly **300** and the driving assembly **20** are fixed, and the first container **11** may be in communication with the second container **12**. The driving assembly **20** may drive the first liquid and the second liquid to flow back and forth between the first container **11** and the second container **12** to complete a predetermined degree of mixing to form a third liquid. The driving assembly **20** may be connected to the first container **11**, the second container **12**, or the first container **11** and the second container **12** simultaneously to drive the first liquid and the second liquid to flow back and forth between the first container **11** and the second container **12**. The driving assembly **20** and the first container **11** or the second container **12** may be directly connected, or may be indirectly connected through other connecting elements, or may be contactlessly connected by a magnetic field, etc.

(12) The first container **11** may include a first tubular cavity **13** and a first piston rod **14**. The first piston rod **14** may be located in the first tubular cavity **13** and have an interference fit with the first tubular cavity **13**. The first piston rod **14** may move relative to the first tubular cavity **13**, and the first liquid may be contained in the cavity formed by the first piston rod **14** and the first tubular cavity **13**. For example, the first container **11** may be a syringe.

(13) The second container **12** may include a second tubular cavity **15** and a second piston rod **16**. The second piston rod **16** may be located in the second tubular cavity **15** and have an interference fit with the second tubular cavity **15**. The second piston rod **16** may move relative to the second tubular cavity **15**, and the second liquid may be contained in the cavity formed by the second piston rod **16** and the second tubular cavity **15**. For example, the second container **12** may be a syringe.

(14) Of course, the second container **12** may not include the second piston **16** but may be a container with an elastic outer wall, such as a rubber bag. In this way, when a liquid flows into the second container **12**, the outer wall of the second container **12** may automatically change its volume through elastic deformation to contain the liquid. When the liquid flows out of the second container **12**, the outer wall of the second container **12** may extrude the liquid through elasticity (i.e., self-drive to discharge the liquid out of the second container **12**).

(15) As mentioned above, when the mixing device **10** is in operation, the first container **11** may be in communication with the second container **12**. The first container **11** may be in direct communication with the second container **12**, for example, the first container **11** and the second container **12** may be connected through a hose, or may be connected through a connector. For example, the connector may be a mixing bin **18**. The mixing bin **18** may include a first opening and a second opening. The first opening may be connected with the first tubular cavity **13**. The second opening may be connected with the second tubular cavity **15**. The mixing bin **18** may provide a certain space while playing a connecting role, so that the liquid in the first container **11** and the second container **12** may be fully mixed. For example, the mixing bin **18** may be a three-way valve.

(16) When the mixing device **10** is working, the driving assembly **20** may be connected with the first piston rod **14** to drive the first piston rod **14** to reciprocate in the first tubular cavity **13**, or may be connected with the second piston rod **16** to drive the second piston rod **16** to reciprocate in the

second tubular cavity **15**, so that the first liquid and the second liquid flow in the first container **11** and the second container **12** to fully mix the first liquid and the second liquid. Specifically, the driving assembly **20** may include a first driving assembly **200** connected to the first piston rod **14**. The driving assembly **20** may include a second driving assembly **400** connected to the second piston rod **16**. The driving assembly **20** may include the first driving assembly **200** alone, the second driving assembly **400** alone, or both the first driving assembly **200** and the second driving assembly **400**.

(17) FIG. **2** shows a schematic structural view of a first clamping assembly **100** in a mixing device **10** according to some embodiments of the present application. Referring to FIG. **2**, the first clamping assembly **100** may include a first fixing assembly **110** and may include a first moving assembly **120**.

(18) The first fixing assembly **110** may be used to fix the first tubular cavity **13** in the first container **11**. As shown in FIG. **2**, in some embodiments, the first fixing assembly **110** may include a first fixing block **111**, a first pressing block **112**, and a first auxiliary pressing plate **115**. The first tubular cavity **13** is set between the first fixing block **111** and the first pressing block **112**. Specifically, the first fixing block **111** is provided with a first mounting groove **113**. The first pressing block **112** is mounted at one end of the first fixing block **111** provided with a first mounting groove **113**. The first pressing block **112** is provided with a first accommodating groove **114**. The first mounting groove **113** and the first accommodating groove **114** enclose a first accommodating cavity (not shown in FIG. **2**) for accommodating the first tubular cavity **13**. Specifically, the first pressing block **112** is mounted on the end surface of the first fixing block **111** by screws, and the height of the first pressing block **112** may be adjusted by rotating the screws, so as to adapt to the first containers **11** of different sizes. When the first container **11** is a syringe, one end of the first tubular cavity **13** near the first piston rod **14** may be provided with a hem. The first auxiliary pressing plate **115** may be installed on one side of the first fixing block **111** close to the first piston rod **14** by screws, and the first auxiliary pressing plate **115** and the first fixing block **111** cooperate to clamp one end of the first tubular cavity **13**, clamping the folded edge of the first tubular cavity **13** between the first auxiliary pressing plate **115** and the first fixing block **111**, thereby further improving the connection stability of the first container **11**.

(19) As previously mentioned, the driving assembly **20** may be connected to the first piston rod **14**. The driving assembly **20** may be directly connected with the first piston rod **14**. For example, the driving assembly **20** is a linear driving mechanism such as an electric push rod or a linear module lamp. The output end of the driving assembly **20** may be directly connected with the first piston rod **14** to drive the first piston rod **14** to reciprocate in the first tubular cavity **13**. The driving assembly **20** may also be indirectly connected to the first piston rod **14** through other connecting elements. For example, the driving assembly **20** may be connected to the first piston rod **14** through the first moving assembly **120**. The driving assembly **20** drives the first moving assembly **120** to move, thereby driving the first piston rod **14** to move relative to the first fixing assembly **110** and the first tubular cavity **13**.

(20) The first moving assembly **120** may be used to fix the first piston rod **14** to the first container **11**. The first moving assembly **120** may include a first moving block **121** and may also include a first pressing plate **122**. The first moving block **121** is connected to the first piston rod **14** and the driving assembly **20**, respectively. The first pressing plate **122** is mounted on the first moving block **121**. The first pressing plate **122** cooperates with the first pressing block **112** to clamp an end of the first piston rod **14** remote from the first tubular cavity **13**, and clamp an end of the first piston rod **14** between the first pressing plate **122** and the first moving block **121**.

(21) FIG. **3** shows a schematic assembly diagram of a first clamping assembly **100** and a second clamping assembly **300** in a mixing device **10** according to some embodiments of the present application. As shown in FIG. **1** and FIG. **3**, the second clamping assembly **300** may include a second fixing assembly **310** and may include a second moving assembly **120**.

(22) The second fixing assembly **310** may be used to fix the second tubular cavity **15** in the second container **12**. Referring to FIG. **3**, in some embodiments, the second fixing assembly **310** may include a second fixing block **311**, a second pressing block **312**, and a second auxiliary pressing plate **315**. The second tubular cavity **15** is set between the second fixing block **311** and the second pressing block **312**. Specifically, the second fixing block **311** is provided with a second mounting groove **313**. The second pressing block **312** is mounted at one end of the second fixing block **311** provided with the second mounting groove **313**. The second pressing block **312** is provided with a second accommodating groove **314**. The second mounting groove **313** and the second accommodating groove **314** enclose a second accommodating cavity (not shown in FIG. **1** and FIG. **3**) for accommodating the second tubular cavity **15**. Specifically, the second pressing block **312** is mounted on the end surface of the second fixing block **311** by screws, and the height of the second pressing block **312** may be adjusted by rotating the screws, so as to adapt to syringes of different sizes. When the second container **12** is a syringe, the end of the second tubular cavity **15** near the second piston rod **16** is provided with a hem. The second auxiliary pressing plate **315** may be installed on the side of the second fixing block **311** close to the second piston rod **16** by screws, and the second auxiliary pressing plate **315** and the second fixing block **311** cooperate to clamp one end of the second tubular cavity **15** and clamp the folded edge of the second tubular cavity **15** between the second auxiliary pressing plate **315** and the second fixing block **311**, thereby further improving the connection stability of the second container **12**.

(23) As previously mentioned, the driving assembly **20** may be connected to the second piston rod **16**. The driving assembly **20** may be directly connected with the second piston rod **16**. For example, the driving assembly **20** is a linear driving assembly such as an electric push rod or a linear module lamp. The output end of the driving assembly **20** is directly connected with the second piston rod **16** to drive the second piston rod **16** to reciprocate in the second tubular cavity **15**. The driving assembly **20** may also be indirectly connected to the second piston rod **16** through other connecting elements. For example, the driving assembly **20** may be connected to the second piston rod **16** through the second moving assembly **320**. The driving assembly **20** drives the second moving assembly **320** to move, thereby driving the second piston rod **16** to move relative to the second fixing assembly **310** and the second tubular cavity **15**.

(24) The second moving assembly **320** may be used to fix the second piston rod **16** to the second container **12**. The second moving assembly **320** may include a second moving block **321** and may also include a second pressing plate **322**. The second moving block **321** is connected to the second piston rod **16** and the driving assembly **20**, respectively. The second pressing plate **322** is mounted on the second moving block **321**. The second pressing plate **322** cooperates with the second pressing block **312** to clamp the end of the second piston rod **16** away from the second tubular cavity **15**, and clamp the end of the second piston rod **16** between the second pressing plate **322** and the second moving block **321**.

(25) As previously mentioned, the first driving assembly **200** may be connected with the first piston rod **14** through the first moving assembly **120** to drive the first moving assembly **120** to move so as to drive the first piston rod **14** to reciprocate in the first tubular cavity **13** to exchange and mix the first liquid in the first container **11** with the second liquid in the second container **12**.

(26) Referring to FIG. **2**, the first driving assembly **200** may include a first driving element **210**, a first connecting rod **220**, and a first slide rail **230**. The first connecting rod **220** penetrates the first moving block **121** and is threadedly connected with the first moving block **121**. Specifically, the first connecting rod **220** may be a screw rod. The first driving element **210** may drive the first connecting rod **220** to rotate. Specifically, the first driving element **210** may be a motor. The motor may convert the voltage signal into torque and rotation speed. The motor drives the first connecting rod **220** to rotate and drives the first moving block **121** to move along the first connecting rod **220**, thereby driving the first piston rod **14** connected to the first moving block **121** to reciprocate in the first tubular cavity **13** of the first container **11**. The first driving element **210** may be a servo motor.

The servo motor may control the first connecting rod **220** and accurately adjust the rotation speed and position accuracy, thereby accurately controlling the moving speed of the first moving block **121** and the first piston rod **14**, thereby controlling the emulsification rate. In other embodiments, the first driving element **210** may also be a stepping motor with lower precision, which is suitable for emulsification processes with low speed and time precision requirements. The first slide rail **230** is set along the length direction of the first connecting rod **220**. The first moving block **121** is slidably mounted on the first slide rail **230**. The rotation of that first connected rod **220** will drive the first moving block **121** to slide along the first slide rail **230**. The first slide rail **230** may enable the first moving block **121** to be guided during moving, and at the same time, may also improve the stability of the first moving block **121** during moving. The first container **11** is arranged parallel to the central axis of the first driving assembly **200**, more specifically, the first tubular cavity **13** is arranged parallel to the central axis of the first connecting rod **220**. The first moving assembly **120** drives the first moving block **121** to move in the axial direction of the first container **11**, thereby driving the first piston rod **14** to reciprocate in the first tubular cavity **13**, thereby exchanging and mixing the first liquid in the first container **11** with the second liquid in the second container **12**.

(27) It should be noted that when the driving assembly **20** does not include the second driving assembly **400**, the first container **11** and the second container **12** is connected through the mixing bin **18** when the mixing device **10** is in operation. The rest of the outlets in the mixing bin **18** are closed. The first driving assembly **200** drives the first piston rod **14** to reciprocate in the first tubular cavity **13**. Under the action of atmospheric pressure, the second piston rod **16** may be driven to reciprocate in the second tubular cavity **15** to emulsify.

(28) As previously mentioned, the driving assembly **20** may include both the first driving assembly **200** and the second driving assembly **400**. The first driving assembly **200** is connected with the first piston rod **14**, the second driving assembly **400** is connected with the second piston rod **16**, and the first driving assembly **200** and the second driving assembly **400** simultaneously drive the first piston rod **14** and the second piston rod **16** to alternately reciprocate, thereby mixing and emulsifying the first liquid and the second liquid.

(29) Referring to FIG. **3**, the second driving assembly **400** may include a second driving element **410**, a second connecting rod **420**, and a second slide rail **430**. The second connecting rod **420** penetrates the second moving block **321** and is screwed with the second moving block **321**. Specifically, the second connecting rod **420** may be a screw rod. The second driving element **410** may drive the second connecting rod **420** to rotate. Specifically, the second driving element **410** may be a motor. The motor may convert the voltage signal into torque and rotation speed. The motor may drive the second connecting rod **420** to rotate to drive the second moving block **321** to move along the second connecting rod **420**, thereby driving the second piston rod **16** connected to the second moving block **321** to reciprocate in the second tubular cavity **15** of the second container **12**. The second driving element **410** may be a servo motor. The servo motor may control the second connecting rod **420** and accurately adjust the rotation speed and position accuracy, thereby accurately controlling the moving speed of the second moving block **321** and the second piston rod **16**, thereby controlling the emulsification rate. In other embodiments, the second driving element **410** may also be a stepping motor with lower precision, which is suitable for emulsification processes with low speed and time precision requirements. The second slide rail **430** is arranged along the length direction of the second connecting rod **420**. The second moving block **321** is slidably mounted on the second slide rail **430**. The rotation of the second connecting rod **420** will drive the second moving block **321** to slide along the second slide rail **430**. The second slide rail **430** may enable the second moving block **321** to be guided during moving, and at the same time, may also improve the stability of the second moving block **321** during moving. The second container **12** is arranged parallel to the central axis of the second driving assembly **400**, and more specifically, the second tubular cavity **15** is arranged parallel to the central axis of the second connecting rod **420**. The second moving assembly **320** drives the second moving block **321** to

move in the axial direction of the second container **12**, thereby driving the second piston rod **16** to reciprocate in the second tubular cavity **15**, thereby exchanging and mixing the second liquid in the second container **12** with the first liquid in the first container **11**.

(30) Referring to FIG. **1** and FIG. **2**, in one embodiment, the mixing device **10** may further include a first adjusting assembly **600**. The first adjusting assembly **600** may include a first bottom plate **610**, a first handle **620**, and a first guide plate **630**. The first bottom plate **610** is the mounting base of the first clamping assembly **100**. The first clamping assembly **100** and the first driving assembly **200** are both mounted on the first bottom plate **610**. Specifically, the first fixing block **111**, the first slide rail **230**, and the first driving element **210** are all mounted on the first bottom plate **610**. It should be noted that the first bottom plate **610** is installed on the machine table **510**, which will be described in detail later. The first bottom plate **610** is provided with a first adjusting groove arranged along the moving direction of the first piston rod **14**. The first adjusting assembly **600** is installed and fixed through the first adjusting groove. The first handle **620** is installed in the first adjusting groove to lock the first bottom plate **610**. Specifically, one end of the first handle **620** is connected with a fastening screw, and the fastening screw penetrates the first adjusting groove and is in threaded connection with the machine table **510**. Turning the first handle **620** to adjust the rotation of the fastening screw may lock the first bottom plate **610** on the machine table **510**. By rotating the first handle **620**, the first bottom plate **610** may adjust the relative position with the machine table **510** within the length range of the first adjusting groove, thereby adjusting the position of the first clamping assembly **100** according to the sizes of the first container **11**, the second container **12** and the mixing bin **18** and carrying out adaptive installation. Further, the first adjusting assembly **600** may further include a first guide plate **630**. The first guide plate **630** is installed on the machine table **510** by screws. The first bottom plate **610** is in contact with the first guide plate **630**. The first guide plate **630** may guide the first bottom plate **610**. The first bottom plate **610** may move along the first guide plate **630** during sliding, thus ensuring that the movement does not deviate.

(31) Referring to FIG. **1** and FIG. **3**, in some embodiments, the mixing device **10** may further include a second adjusting assembly **700**. The second adjusting assembly **700** may include a second bottom plate **710**, a second handle **720** and a second guide plate **730**. The second bottom plate **710** is the mounting base of the second clamping assembly **300**. The second clamping assembly **300** and the second driving assembly **400** may both be mounted on the second bottom plate **710**. Specifically, the second fixing block **311**, the second slide rail **430**, and the second driving element **410** are all mounted on the second bottom plate **710**. It should be noted that the second bottom plate **710** is installed on the machine table **510**, which will be described in detail later. The second bottom plate **710** is provided with a second adjusting groove arranged along the moving direction of the second piston rod **16**. The second adjusting assembly **700** is installed and fixed through the second adjusting groove. The second handle **720** is installed in the second adjusting groove to lock the second bottom plate **710**. Specifically, one end of the second handle **720** is connected with a fastening screw. The fastening screw penetrates through the second adjusting groove and is in threaded connection with the machine table **510**. Turning the second handle **720** to adjust the rotation of the fastening screw may lock the second bottom plate **710** on the machine table **510**. By rotating the second handle **720**, the second bottom plate **710** may adjust the relative position with the machine **510** within the length range of the second adjusting groove, so as to adjust the position of the second clamping assembly **300** according to the sizes of the first container **11**, the second container **12** and the mixing bin **18** and carry out adaptive installation. Further, the second adjusting assembly **700** further includes a second guide plate **730**, which is installed on the machine table **510** by screws, the bottom plate is in contact with the second guide plate **730**, the second guide plate **730** may guide the second bottom plate **710**, and the second bottom plate **710** may move along the second guide plate **730** during sliding, thus ensuring that the movement does not deviate.

(32) As shown in FIG. **3**, the mixing device **10** may further include a third clamping assembly **800**.

The third clamping assembly **800** may be used to fix the mixing bin **18** that provides communication between the first container **11** and the second container **12**. The third clamping assembly **800** is installed between the first clamping assembly **100** and the second clamping assembly **300**. The first container **11** and the second container **12** are respectively communicated with the mixing bin **18**. Specifically, the first clamping assembly **100** and the third clamping assembly **800** are in the same straight line. The second clamping assembly **300** and the third clamping assembly **800** are in the same straight line. When the mixing bin **18** is a three-way valve, in order to facilitate the connection of the three-way valve with the first container **11** and the second container **12**, the included angle between the extension line of the straight line where the first clamping assembly **100** is located and the extension line of the straight line where the second clamping assembly **300** is located is 90 degrees. Of course, depending on the structure of the mixing bin **18**, the included angle between the extension line of the straight line where the first clamping assembly **100** is located and the extension line of the straight line where the second clamping assembly **300** is located may also be at other angles, for example, the extension line of the straight line where the first clamping assembly **100** is located and the extension line of the straight line where the second clamping assembly **300** is located are parallel, or the extension line of the straight line where the first clamping assembly **100** is located and the extension line of the straight line where the second clamping assembly **300** is located are a straight line, etc.

(33) The third clamping assembly **800** may include a fixing base **810**, a lifting rod **820**, and an adjusting element **830**. The fixing base **810** is provided with an accommodating cavity. The lifting rod **820** is telescopically arranged in the accommodating cavity, and may lift relative to the fixing base **810** and may be fixed relative to the fixing base **810**. The end of the lifting rod **820** remote from the fixing base **810** is provided with a groove, and the groove is used for clamping the mixing bin **18**. The shape of the bottom of the mixing bin **18** matches the shape of the groove. The bottom of the mixing bin **18** may be circular, and the mixing bin **18** is clamped in the groove through the circular bottom and fixed on the lifting rod **820**. Of course, the bottom of the mixing bin **18** may have other shapes, such as square, etc. The adjusting element **830** penetrates the fixing base **810** into the accommodating cavity, abuts against the lifting rod **820**, and locks the lifting rod **820** with the fixing base **810**. Specifically, the adjusting element **830** may be a fastening screw, and adjusting the fastening screw may lock or release the lifting rod **820**, thereby adjusting the height of the lifting rod **820** relative to the fixing base **810**, so that the first container **11** and the second container **12** are flush (i.e., having the same height) with the height of the first clamping assembly **100** and the second clamping assembly **300**, hence complete the adaptive installation.

(34) The machine table **510** is a base on which the mixing device **10** is mounted. The first clamping assembly **100**, the second clamping assembly **300**, the driving assembly **20**, the third clamping assembly **800**, the first adjusting assembly **600**, the second adjusting assembly **700**, and the control assembly **500** may all be installed on the machine table **510**. The first bottom plate **610** and the second bottom plate **710** are both installed on the machine table **510**.

(35) As shown in FIG. **1**, the mixing device **10** may further include a control assembly **500**. The control assembly **500** may be communicatively connected with (e.g., in communication with, such as electrically connected with) the driving assembly **20**, and may control the speed of reciprocating motion of the first piston rod **14** in the first tubular cavity **13** and the speed of reciprocating motion of the second piston rod **16** in the second tubular cavity **15**. Therefore, the pumping speed of the first container **11** and the second container **12** may be precisely controlled, so as to control the flow speed of the first liquid and the second liquid in the first container **11** and the second container **12**, thereby controlling the emulsification rate and the emulsification effect, and further researching and preparing iodized oil emulsions with better physicochemical characteristics, obtaining emulsions with better emulsification effect, and improving the treatment effect. Research shows that the faster the pumping speed, the smaller the droplet size of the emulsion, and the higher the viscosity of the emulsion, the better the emulsifying effect is obtained. In addition, since the first

container **11** and the second container **12** have different capacity specifications and may bear different pressures, there is a possibility of breakage of the first container **11**, the second container **12**, the mixing chamber **18**, etc., resulting in waste of drugs, which in turn increases the risk of doctors. In this case, by adjusting the speeds of the first piston rod **14** and the second piston rod **16**, the pressure applied to the first container **11**, the second container **12** and the mixing bin **18** may be adjusted to prevent the first container **11**, the second container **12** and the mixing bin **18** from being damaged. As shown in FIG. **1**, the control assembly **500** may include an electronic control system (not shown in FIG. **1**) and may also include a single chip microcomputer (not shown in FIG. **1**). In some embodiments, the control assembly **500** may further include a display **520**, a power switch **530**, and an emergency stop switch **540**.

(36) The electric control system is installed inside the machine table **510**. The electronic control system may be communicatively connected with the first driving element **210** and the second driving element **410**. The electronic control system may control the speed and duration of the movement of the first moving assembly **120** driven by the first driving assembly **200**, and the speed and duration of the movement of the second moving assembly **320** driven by the second driving assembly **400**.

(37) Specifically, the control assembly **500** is communicatively connected with the first driving element **210** and the second driving element **410** through the electronic control system, and may control the speed at which the first driving assembly **200** drives the first piston rod **14** to reciprocate and the speed at which the second driving assembly **400** drives the second piston rod **16** to reciprocate. When the driving speed is fixed, by controlling the duration of driving the first piston rod **14** by the first driving element **210** and the duration of driving the second piston rod **16** by the second driving element **410**, the number of reciprocations of the first piston rod **14** and the second piston rod **16** may be controlled and the pumping times may be adjusted. Research shows that the pumping times have a slight influence on the droplet size of the emulsion. The more pumping times, the smaller the particle size and the greater the stability. To a certain extent, the emulsion is more fully emulsified.

(38) The single chip microcomputer is connected with the electric control system. The single chip microcomputer may store the parameters of the electric control system, including the parameters of the moving speed of the first moving assembly **120** driven by the first driving assembly **200** and the moving speed of the second moving assembly **320** driven by the second driving assembly **400**.

(39) Referring to FIG. **1**, the control assembly **500** may further include a display **520**. The display **520** is installed on the machine table **510**. The display **520** may be a touch screen, and a control instruction may be input through a touch operation. After the first container **11** and the second container **12** are respectively installed on the first clamping assembly **100** and the second clamping assembly **300**, the first driving element **210** and the second driving element **410** respectively drive the first moving block **121** and the second moving block **321** to slide to corresponding positions, that is, installation positions, to fix the first container **11** and the second container **12**. The torques of the first driving element **210** and the second driving element **410** at this time are recorded by the touch screen. The parameter information of the installation position recorded may be retained when the mixing device **10** is turned on again after shutdown, thus the mixing device **10** may be directly installed when the syringe with the same specification and liquid capacity as the previous one is used, without repeatedly adjusting the relative positions of the first moving block **121** and the second moving block **321**. In addition, during pumping, the starting position and the ending position of pumping may be set according to specific configuration requirements, and the first driving element **210** and the second driving element **410** drive the first piston rod **14** and the second piston rod **16** to reach the starting position and the ending position respectively. Specifically, the pumping of the first piston rod **14** and the second piston rod **16** is performed alternately to complete the emulsification process. When emulsions with different volume proportions are prepared, different volumes of liquid will be injected into the first container **11** and the second

container **12**. The starting position and ending position may be changed, and the pumping configuration information may be changed. At the same time, the installation position, the starting position and the ending position may be reserved when the power is switched on after turned off, when the first container **11** and the second container **12** with the same specifications and the same liquid capacity are used as the last time, the process of repeatedly setting the motion position parameters may be avoided, repeated emulsification is realized, the work efficiency is high, and the repeatability of the emulsification effect is high.

(40) Referring to FIG. **1**, in some embodiments, the control assembly **500** may further include a power switch **530** and an emergency stop switch **540**. The power switch **530** and the emergency stop switch **540** are arranged on the machine table **510**. The power switch **530** may be pressed to start the mixing device **10**, and the emergency stop switch **540** may be pressed at any time during an operation of the mixing device **10** to stop the emulsification process, so that the emergency treatment may be carried out when an emergency occurs.

(41) The present specification further provides a liquid mixing method suitable for the mixing device **10**. FIG. **4** shows a flow chart P**400** of a liquid mixing method according to some embodiment of the present application. The method comprises the following steps:

(42) S**410**: Fill the first container **11** with the first liquid.

(43) S**420**: Fill the second container **12** with the second liquid.

(44) When the mixing device **10** is used for liquid mixing, the first container **11** and the second container **12** need to be respectively filled with the first liquid and the second liquid to be configured. The first container **11** and the second container **12** are in communication. As mentioned above, the first container **11** and the second container **12** may be connected directly, for example, through a hose, or through a connector such as a mixing bin **18**. The mixing bin **18** is between the first container **11** and the second container **12**. When the mixing bin **18** is used for communication, the first container **11** and the second container **12** need to be respectively in communication with the mixing bin **18**. The method P**400** may further include:

(45) S**430**: Connect the first container **11** with a first opening of the mixing bin **18**.

(46) S**440**: Connect the second container **12** with a second opening of the mixing bin **18**.

(47) If the mixing bin **18** further includes other openings, the other openings need to be closed. For example, a three-way valve includes three openings, and the third opening of the three-way valve needs to be closed.

(48) In order to make the mixing device **10** work better, the first container **11**, the second container **12** and the mixing bin **18** need to be fixed. Therefore, the method P**400** may further include:

(49) S**450**: Install the mixing bin **18** on the third clamping assembly **800** of the mixing device **10**, and adjust the height of the mixing bin **18** on the third clamping assembly **800** so that the first container **11** and the second container **12** are flush with the first clamping assembly **100** and the second clamping assembly **300** in height, respectively.

(50) After the first container **11** and the second container **12** are connected to the mixing bin **18**, the first container **11**, the second container **12**, and the mixing bin **18** need to be mounted to the mixing device **10** for liquid mixing. Specifically, the mixing bin **18** needs to be installed on the third clamping assembly **800** first. Step S**430** specifically includes: installing the mixing bin **18** on the lifting rod **820**; the height of the lifting rod **820** is adjusted by operating the adjusting element **830** so that the first container **11** and the second container **12** are flush with the first clamping assembly **100** and the second clamping assembly **300**, so that the first container **11** and the second container **12** may be installed on the first clamping assembly **100** and the second clamping assembly **300**.

(51) S**460**: Fix the first container **11** to the first clamping assembly **100**.

(52) Step S**460** may include: adjusting the position of the first clamping assembly **100** relative to the mixing bin **18** so that the first container **11** can be mounted on the first clamping assembly **100** and fixing the first clamping assembly **100**; and fixing the first container **11** to the first clamping assembly **100**. Specifically, the first adjusting assembly **600** may be operated to change the distance

of the first bottom plate **610** relative to the mixing bin **18** so that the first container **11** can be mounted to the first fixing assembly **110**; after the position of the first bottom plate **610** is adjusted, the first bottom plate **610** and the machine **510** are fixed to fix the first clamping assembly **100** to the machine table **510**; then, the first tubular cavity **13** of the first container **11** is fixed to the first fixing assembly **110**, and the first piston rod **14** is fixed to the first moving assembly **120**.
(53) S**470**: Fix the second container **12** to the second clamping assembly **300** of the mixing device **10**.
(54) Step S**470** may include: adjusting the position of the second clamping assembly **300** relative to the mixing bin **18** so that the second container **12** can be mounted on the second clamping assembly **300** and fixing the second clamping assembly **300**; and fixing the second container **12** to the second clamping assembly **300**. Specifically, the second adjusting assembly **700** may be operated to change the distance of the second bottom plate **710** relative to the mixing bin **18** so that the second container **12** can be mounted to the second fixing assembly **310**; after the position of the second bottom plate **710** is adjusted, the second bottom plate **710** and the machine **510** are fixed to fix the second clamping assembly **300** to the machine **510**; then, the second tubular cavity **15** of the second container **12** is fixed to the second fixing assembly **310**, and the second piston rod **16** is fixed to the second moving assembly **320**.
(55) In clinical practice, different volume proportions of iodized oil, chemotherapeutic drug aqueous liquid or iodine-containing contrast agent need to be selected for preparing the iodized oil emulsion. In the preparing process, syringes with different volume specifications need to be selected for repeated suction and pumping. As the diameters and lengths of syringes with different specifications are different, the syringes with different diameters and lengths may be installed and fixed by the third clamping assembly **800**, the first adjusting assembly **600** and the second adjusting assembly **700**. Thus, the liquid in the first tubular cavity **13** and the liquid in the second tubular cavity **15** are uniformly mixed.
(56) S**480**: the driving assembly **20** of the mixing device **10** drives the first liquid and the second liquid to flow back and forth between the first container **11** and the second container **12** to complete a predetermined degree of mixing to form a third liquid.
(57) Specifically, the first liquid and the second liquid may flow back and forth between the first container **11** and the second container **12** through the mixing bin **18**. As mentioned above, the driving assembly **20** may be connected to the first piston rod **14**, and step S**480** may include: the driving assembly **20** driving the first piston rod **14** to reciprocate in the first tubular cavity **13** to drive the first liquid and the second liquid to reciprocate between the first container **11** and the second container **12**. As mentioned above, the driving assembly **20** may be connected to the second piston rod **16**, and step S**480** may further include: the driving assembly **20** driving the second piston rod **16** to reciprocate in the second tubular cavity **15** to drive the first liquid and the second liquid to reciprocate between the first container **11** and the second container **12**.
(58) After mixing, the third liquid may be taken out of the mixing bin **18**. The mixing bin **18** may also include an outlet through which the third liquid may be discharged. For example, the opening may be provided without cutting off the communication between the first container and the second container, and then the driving assembly **20** may drive the third liquid to flow out of the third opening. Therefore, the method P**400** may further include:
(59) S**490**: the driving assembly **20** drives the third liquid to exit the third liquid from the outlet.
(60) Of course, the third liquid may be discharged from the first opening and/or the second opening of the mixing bin **18**. For example, the driving assembly **20** may drive the third liquid to flow into the first container; then the mixing bin **18** is disconnected from the second container; then the driving assembly **20** may drive the third liquid to flow out of the first container and discharge the third liquid from the first opening of the mixing bin **18**. Of course, the third liquid may also be drawn to the first container **11** or the second container **12** by the driving assembly **20**, and then discharged from the first container **11** or the second container **12**.

(61) In summary, according to the mixing device **10** and the liquid mixing method provided in this specification, the first container **11** containing the first liquid and the second container **12** containing the second liquid are fixed through the first clamping assembly **100** and the second clamping assembly **300**, the first container **11** is communicated to the second container **12**; the first piston rod **14** of the first container **11** and the second piston rod **16** of the second container **12** are driven by the driving assembly **20**, so that the first liquid and the second liquid flow back and forth between the first container **11** and the second container **12**, thereby uniformly mixing the first liquid and the second liquid; the speed and duration of the reciprocating motion of the first piston rod **14** and the second piston rod **16** are controlled by the control assembly **500**, thereby controlling the emulsifying rate and emulsifying effect when the first liquid and the second liquid are mixed. The mixing device **10** and the liquid mixing method can fully and uniformly mix the first liquid and the second liquid, thereby obtaining an emulsion with better emulsifying effect and improving the treatment effect.
(62) The technical features of the above embodiments can be combined arbitrarily. For the sake of brevity, not all possible combinations of the technical features of the above embodiments have been described. However, as long as there is no contradiction in the combination of these technical features, it should be considered as the scope recorded in this specification.
(63) The above examples represent only a few embodiments of the present invention, and their descriptions are more specific and detailed, but they should not be construed as limiting the scope of the invention. It should be pointed out that for those skilled in the art, several modifications and improvements can be made without departing from the concept of the present invention, which are all within the scope of protection of the present invention. Therefore, the scope of protection of the present invention shall be subject to the appended claims.

Claims

1. A mixing device, comprising: a first clamping assembly, including a first fixing assembly configured to fix a first tubular cavity of a first container, which is for containing a first liquid; a second clamping assembly, including a second fixing assembly configured to fix a second tubular cavity of a second container, which is used for containing a second liquid, wherein upon fixing the first container with the first clamping assembly and fixing the second container with the second clamping assembly, the first container and the second container are in an angled arrangement and in communication with each other; and a driving assembly, including: a first driving element to connect to a first piston of the first container, wherein the first piston locates in the first tubular cavity and has an interference fit with the first tubular cavity, and a second driving element, capable of operating independently from the first driving element, to connect to a second piston of the second container, wherein the second piston locates in the second tubular cavity and has an interference fit with the second tubular cavity; wherein, during operation, the driving assembly drives the first piston to reciprocate in the first tubular cavity and drives the second piston to reciprocate in the second tubular cavity, so as to drive the first liquid and the second liquid to flow back and forth between the first container and the second container to complete a predetermined degree of mixing, thereby forming a third liquid.
2. The mixing device of claim 1, further comprising: a control assembly to control a speed at which the driving assembly drives the first liquid and the second liquid to flow; and a machine table, wherein the first clamping assembly, the second clamping assembly, the driving assembly and the control assembly are mounted on the machine table.
3. The mixing device of claim 1, wherein the first fixing assembly includes: a first fixing block provided with a first mounting groove; and a first pressing block at one end of the first fixing block provided with the first mounting groove, the first pressing block being provided with a first accommodating groove, wherein, the first mounting groove and the first accommodating groove

enclose a first accommodating cavity for accommodating the first tubular cavity.
4. The mixing device of claim 1, wherein when the mixing device is in operation, the first tubular cavity is in communication with the second tubular cavity, and the driving assembly is connected with the first piston to drive the first piston to reciprocate in the first tubular cavity so that the first liquid and the second liquid flow back and forth between the first container and the second container.
5. The mixing device of claim 4, wherein the first clamping assembly further includes a first moving assembly configured to fix the first piston, and the driving assembly is connected with the first piston through the first moving assembly.
6. The mixing device of claim 5, wherein the first moving assembly includes: a first moving block, having ends being respectively connected to the first piston and the driving assembly; and a first pressing plate installed on one end of the first moving block connected with the first piston, and the first pressing plate being configured to cooperate with the first pressing block to clamp one end of the first piston remote from the first tubular cavity.
7. The mixing device of claim 6, wherein the driving assembly includes: a first connecting rod which penetrates the first moving block and is in threaded connection with the first moving block; and a first driving element which drives the first connecting rod to rotate.
8. The mixing device of claim 7, wherein the driving assembly further includes: a first slide rail arranged along a length direction of the first connecting rod, wherein, the first moving block is slidably mounted on the first slide rail, and the first connecting rod drives the first moving block to slide along the first slide rail through rotation.
9. The mixing device of claim 4, wherein when the mixing device is in operation, the driving assembly is connected with the second piston to drive the second piston to reciprocate in the second tubular cavity so that the first liquid and the second liquid flow back and forth between the first container and the second container.
10. The mixing device of claim 9, wherein the second clamping assembly further includes a second moving assembly configured to fix the second piston, and the driving assembly is connected with the second piston through the second moving assembly.
11. The mixing device of claim 1, further comprising a first adjusting assembly including: a first bottom plate, the first clamping assembly being installed on the first bottom plate, and the first bottom plate being provided with a first adjusting groove, wherein, the first clamping assembly performs position adjustment through the first adjusting groove.
12. The mixing device of claim 1, further comprising a second adjusting assembly including: a second bottom plate, the second clamping assembly is installed on the second bottom plate, the second bottom plate is provided with a second adjusting groove, wherein, the second clamping assembly adjusts the position through the second adjusting groove.
13. The mixing device of claim 1, further comprising: a third clamping assembly installed between the first clamping assembly and the second clamping assembly to fix a mixing bin, wherein when the mixing device is in operation, the first container and the second container are communicated through the mixing bin.