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Detection probe, transmission apparatus, and detection device

Abstract

A detection probe, a transmission apparatus, and a detection device are provided. The detection probe includes a housing, a detection mechanism, a driving mechanism, and a rope transmission mechanism. The housing defines an accommodation space. The detection mechanism is arranged on one end of the housing, and is configured to perform a detection function. The driving mechanism is arranged in the accommodation space, and is configured to output a force. The rope transmission mechanism is arranged in the accommodation space, and includes a rope set and a tension member. One end of the rope set is connected to the driving mechanism, and other end of the rope set is connected to the detection mechanism. The tension member is connected to the rope set, and is configured to apply a force to one end of the rope set away from the detection mechanism.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) The present disclosure is a continuation of International Patent Application No. PCT/CN2021/082439, filed Mar. 23, 2021, the contents of which is herein incorporated by reference in its entirety.

TECHNICAL FIELD
(1) The present disclosure relates to the field of medical devices, in particular to a detection probe, a transmission apparatus, and a detection device.
BACKGROUND
(2) A detection probe for medical detection, such as an ultrasonic probe, is capable of transmitting

an ultrasonic signal for detection through an acoustic head assembly, receiving an ultrasonic signal including detection information, and acquiring a detection result by analysis.
(3) In a practical application, in order to improve an accuracy and a comprehensiveness of the detection result, different parts may be detected by driving the acoustic head assembly to swing. However, due to factors such as limitations of a structure and a space of the detection probe, requirements for a transmission mechanism configured to transmit a driving force to the acoustic head assembly are increasingly high.

SUMMARY

(4) In order to solve the above problem, a solution of the present disclosure is to provide a detection probe. The detection probe includes a housing, a detection mechanism, a driving mechanism, and a rope transmission mechanism. The housing defines an accommodation space. The detection mechanism is arranged on one end of the housing, and is configured to perform a detection function. The driving mechanism is arranged in the accommodation space, and is configured to output a force. The rope transmission mechanism is arranged in the accommodation space, and includes a rope set and a tension member. One end of the rope set is connected to the driving mechanism, and other end of the rope set is connected to the detection mechanism. The rope set is configured to receive the force output by the driving mechanism, transmit the force to the detection mechanism, and drive the detection mechanism to move. The tension member is connected to the rope set, is configured to apply a force to one end of the rope set away from the detection mechanism and enable the rope set to be in a tension state.
(5) In order to solve the above problem, a solution of the present disclosure is to provide a transmission apparatus. The transmission apparatus is arranged in a detection probe including a detection mechanism and a driving mechanism. The transmission apparatus includes a rope set and a tension member. One end of the rope set is connected to the driving mechanism, and other end of the rope set is connected to the detection mechanism. The rope set is configured to receive a force output by the driving mechanism, transmit the force to the detection mechanism, and drive the detection mechanism to move. The tension member is connected to the rope set, is configured to apply a force to an end of the rope set away from the detection mechanism and enable the rope set to be in a tension state.
(6) In order to solve the above problem, a solution of the present disclosure is to provide a detection device. The detection device includes a host and the detection probe mentioned above. The host is connected to a detection mechanism and a driving mechanism of the detection probe, configured to control the driving mechanism to output a force and control the detection mechanism to perform a detection function.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) In order to make technical solutions described in some embodiments of the present disclosure or in the related art more clearly, the drawings used for description of some embodiments or the related art will be described. Apparently, the drawings in the following description only illustrate some embodiments of the present disclosure. For those skilled in the art, other drawings may be acquired according to the drawings without any creative work.
(2) FIG. **1** is a structural schematic view of a detection device according to some embodiments of the present disclosure.
(3) FIG. **2** is a structural schematic view of a detection probe according to some embodiments of the present disclosure.
(4) FIG. **3** is a structural schematic view of a partial detection probe according to some embodiments of the present disclosure.

(5) FIG. **4** is an explosive structural schematic view of a detection mechanism of a detection probe according to some embodiments of the present disclosure.
(6) FIG. **5** is an enlarged structural schematic view of a part A shown in FIG. **3**.
(7) FIG. **6** is an explosive structural schematic view of a partial detection probe according to some embodiments of the present disclosure.
(8) FIG. **7** is a structural schematic view of an assembly base of a detection probe according to some embodiments of the present disclosure.
(9) FIG. **8** is a structural schematic view of a partial gear transmission mechanism of a detection probe according to some embodiments of the present disclosure.
(10) FIG. **9** is a structural schematic view of a partial gear transmission mechanism of a detection probe according to some embodiments of the present disclosure.
(11) FIG. **10** is a structural schematic view of a rope wheel of a detection probe according to some embodiments of the present disclosure.
(12) FIG. **11** is a structural schematic view of a partial transmission apparatus of a detection probe according to some embodiments of the present disclosure.

DETAILED DESCRIPTION

(13) In order to make the object, the technical solutions and the technical effect of the present disclosure more clearly, the present disclosure is further explained in detail below in combination with the drawings and some embodiments. It should be understood that some embodiments described in the description are only for a purpose of interpreting the present disclosure and not for a purpose of limiting the present disclosure. Without conflict, an embodiment or a feature of the present disclosure may be combined with some other embodiments of the present disclosure and/or some other features.
(14) Some embodiments of the present disclosure provide a detection device configured to detect a body surface and/or an internal body tissue to acquire a detection result. In some application scenarios, the detection device may also be configured to detect an animal, which is not limited.
(15) As shown in FIG. **1**, in some embodiments, the detection device may include a detection probe **1000** and a host **2000**. The detection probe **1000** may be connected to the host **2000** in a wired or wireless manner, thereby detecting a to-be-detected part of a human body under a control of the host **2000**.
(16) The detection probe **1000** may be a 3-dimensional (D) mechanical probe, a 4-D mechanical probe, or the like, i.e., an ultrasonic probe having a 3-D/4-D imaging function. Under a control signal of the host **2000**, the detection probe **1000** transmits an ultrasonic signal to the human body tissue and receives an echo signal carrying human body tissue information. The host **2000** images the human body tissue by processing the echo signal of the detection probe **1000**, such that a 3-D/4-D image of the human body tissue is constructed for medical analysis. For example, a gynecological examination or the like may be performed by the 3-D/4-D mechanical probe.
(17) The detection probe **1000** may also be configured for other purposes, such as transmitting electrical stimulation to human tissues, performing physical massage, or the like under the control signal of the host **2000**, which are not limited.
(18) In some embodiments, as shown in FIGS. **2** and **3**, the detection probe **1000** may include a housing **100**, a detection mechanism **200**, a transmission apparatus **300**, a driving mechanism **400**, a tail sleeve assembly **500**, a mounting assembly **600**, and the like. The transmission apparatus **300** may be connected to the driving mechanism **400** and the detection mechanism **200**. The host **2000** may be connected to the driving mechanism **400** and the detection mechanism **200** through the tail sleeve assembly **500**, and may control operation of the driving mechanism **400** to drive the transmission apparatus **300** to drive the detection mechanism **200** to move. The detection mechanism **200** may feed back detected information to the host **2000** for analysis and processing to acquire a detection result.
(19) In some embodiments, the detection probe **1000** may include more or less structures than the

above structures, which may be selected according to a practical need, and are not limited.
(20) The housing **100** defines an accommodation space **110**, and one end of the housing **100** has an opening **120** in communication with the accommodation space **110**. The accommodation space **110** is configured to accommodate at least partially internal structure of the detection probe **1000** to support and protect the internal structure.
(21) The housing **100** may be a one-piece structure or may be separately assembled from a plurality of different parts. In some embodiments, the housing **100** may include an insertion portion **130** and a holding portion **140**, which are connected to each other to jointly form the housing **100**. The insertion portion **130** and the holding portion **140** may be connected to each other through at least one of adhesive bonding, clamping, or buckling, etc., which is not limited.
(22) Correspondingly, the insertion portion **130** and the holding portion **140** may correspond to an extension region **111** and an accommodation region **112** of the accommodation space **110** respectively, and the transmission apparatus **300** and the driving mechanism **400** may be accommodated in the extension region **111** and the accommodation region **112** respectively. It should be noted that, in some embodiments of the present disclosure, a corresponding relationship between each region of the accommodation space **110** and each functional mechanism is not limited. For example, in some application scenarios, a part of the transmission apparatus **300** may be accommodated in the extension region **111**, and other part of the transmission apparatus **300** may be accommodated in the accommodation region **112**, which may be configured according to a practical situation.
(23) In some embodiments, a shape, a size, and the like of each part of the housing **100** may be determined according to its function, a shape, a size, and a function of an internal structure accommodated in a corresponding region of the accommodation space **110**.
(24) It should be noted that the detection probe **1000** in some embodiments may be inserted into the human body to detect internal tissues of the human body. In a practical operation, the detection mechanism **200** is located at a “head”. An operator holds the holding portion **140**, and inserts the detection mechanism **200** into the body to perform the detection function through an extension of the insertion portion **130**, and the tail sleeve assembly **500** is located outside the human body, so as to facilitate each functional mechanism corresponding each part of the detection probe **1000** to perform a corresponding function.
(25) In some embodiments, as shown in FIG. **4**, the detection mechanism **200** may include an acoustic window **210**, an energy conversion element **220**, a mounting base **230**, and a supporting bracket **240**.
(26) The energy conversion element **220** may establish a connection relationship with the host **2000**, transmit an ultrasonic wave served as a detection signal to a to-be-detected tissue of the human body according to the control signal transmitted by the host **2000**, and receive a feedback signal carrying detection information.
(27) The acoustic window **210** may have a property of letting acoustic wave pass through, and may be arranged at a periphery of the energy conversion element **220**. In some embodiments, the acoustic window **21** may be arranged at the opening **120** at one end of the housing **100**, and may wrap and be arranged outside the energy conversion element **220**, the mounting base **230**, and the supporting bracket **240**. It should be noted that, in a practical application, coupling liquid for ultrasonic transmission may be filled between the acoustic window **210** and the energy conversion element **220**, so as to transmit an ultrasonic wave detection signal and receive a feedback signal through a cooperation of the energy conversion element **220**, the coupling liquid and the acoustic window **210**.
(28) The mounting base **230** defines an assembly position **231** configured to accommodate the energy conversion element **220** to assemble the energy conversion element **220** on the mounting base **230**. In some embodiments, the energy conversion element **220** may be attached to the assembly position **231** by an adhesive, such as an epoxy adhesive. In addition, assembly grooves

232 may be defined on two side of the mounting base **230**, and may be configured to assemble some components of the transmission apparatus **300**, so as to connect to the transmission apparatus **300**.

(29) The supporting bracket **240** may be configured to support the mounting base **230**, thereby supporting the energy conversion element **220**. In some embodiments, the supporting bracket **240** may be in a shape of annular, such as a circular ring, a square ring, or the like. The shape of the supporting bracket **240** may match a shape of an inner wall of the housing **100** at the opening **120**, and may be arranged on the inner wall of the housing **100** at the opening **120**.

(30) The supporting bracket **240** may include two concave arc supporting platforms **241** having concave arc supporting surfaces. In some embodiments, the mounting base **230** may also have two cylindrical protrusions **233** arranged on two sides of the mounting base **230** respectively, and the cylindrical protrusions **233** may have arc side surfaces respectively configured to be movably supported on corresponding concave arc supporting surfaces of the supporting bracket **240**, such that the mounting base **230** may swing under the support of the concave arc supporting platform **241**. In this way, in response to the mounting base **230** being subjected to a force applied by the drive device **300**, the mounting base **230** may drive the energy conversion element **220** to perform reciprocating swing along certain directions.

(31) In some embodiments, as shown in FIGS. **3**, **5** and **6**, the transmission apparatus **300** may include a gear transmission mechanism **340**, a rope transmission mechanism **350**, and the like.

(32) In some embodiments, the gear transmission mechanism **340** may be connected to the driving mechanism **400** and the rope transmission mechanism **350** to receive a force output by the driving mechanism **400** and transmit the force to the rope transmission mechanism **350**. The rope transmission mechanism **350** is connected to the detection mechanism **200**, and drives the detection mechanism **200** to move in response to the rope transmission mechanism **350** receiving the force transmitted by the gear transmission mechanism **340**, thereby implementing a detection.

(33) The transmission apparatus **300** may be arranged in the accommodation space **110** through the mounting assembly **600**. In some embodiments, the transmission apparatus **30** may be arranged on the inner wall of the housing **100**. In some embodiments, the mounting assembly **600** may include an assembly base **610**, and the drive **300** may be arranged on the inner wall of the housing **100** through the assembly base **610**.

(34) In some embodiments, as shown in FIG. **7**, the assembly base **610** may include an assembly base body **611**, a first supporting bracket **612**, and a second supporting bracket **613**.

(35) The assembly base body **611** may be arranged on the housing **100** and surrounded by the inner side wall of the housing **100**. In some embodiments, the assembly base body **611** may be arranged on one end of the insertion portion **130** close to the holding portion **140**, and may be arranged through adhesive bonding, clamping, interference fitting, or the like. In some embodiments, at least partial shape of the assembly base body **611** may also match the shape of the inner side wall of the housing **100** at an assembly location, such that a connection between the assembly base body **611** and the inner side wall of the housing **100** is hermetically sealed, thereby separating the extension region **111** of the accommodation space **110** from the accommodation region **112** of the accommodation space **110**.

(36) In some embodiments, the assembly base body **611** defines an assembly hole **6111** extending through the assembly base body **611**, and the assembly base body **611** and the receiving areas **112** respectively arranged on two sides of the assembly base body **611** may be in communication with each other through the assembly hole **6111**. The mounting assembly **600** may also include a seal member **620** arranged in the assembly hole **6111**.

(37) The first supporting bracket **612** and the second supporting bracket **613** are spaced apart from each other and arranged on two sides of the assembly holes **6111** respectively, are connected to one side of the assembly base body **611** facing the extension region **111**, and defines a first assembly position **6121** and a second assembly position **6131** respectively.

(38) The assembly base body **611**, the first supporting bracket **612** and the second supporting bracket **613** may be independent structures respectively, and the first supporting bracket **612** and the second supporting bracket **613** may be arranged on the assembly base body **611** through bonding, clamping, screwing, or plugging, etc. In some embodiments, all or some of the assembly base body **611**, the first supporting bracket **612**, and the second supporting bracket **613** may also be a one-piece structure, which are not limited.

(39) In some embodiments, the gear transmission mechanism **340** may include a driving shaft **341**, a driving gear **342**, a driven gear **343**, a driven shaft **344**, a first bearing **345**, a second bearing **346**, a third bearing **347**, a fasten member **348**, and the like.

(40) One end of the driving shaft **341** is located on the extension region **111**. Other end of the driving shaft **341** penetrates the assembly hole **6111** of the assembly base body **611**, enters the accommodation region **112**, and is connected to the driving mechanism **400**.

(41) In some embodiments, the transmission apparatus **300** may also include a shaft coupling **360**. The other end of the driving shaft **341** may be connected to the shaft coupling **360** through the assembly hole **6111**, and may be connected to an output end of the driving mechanism **400** through the shaft coupling **360**, such that the driving mechanism **400** may drive the driving shaft **341** to rotate.

(42) In some embodiments, the third bearing **347** may be sleeved on a periphery of the driving shaft **341** and arranged in the assembly hole **6111** to support a rotation of the driving shaft **341**. The seal member **620** may be an oil seal, such as a framework oil seal or the like, and may be sleeved on the periphery of the driving shaft **341** and arranged in the assembly hole **6111** to seal the assembly hole **6111**, thereby further separating the extension region **111** from the receptacle region **112**.

(43) The driving gear **342** is arranged on one end of the driving shaft **341** at the extension region **111** and rotates synchronously with the driving shaft **341** under a drive of the driving mechanism **400**. It should be noted that the driving gear **342** and the driving shaft **341** may be independent structures, and may be connected together in a certain manner. In some embodiments, the driving shaft **341** and the driving gear **342** may also be a one-piece structure, that is, the driving shaft **341** and the driving gear **342** form a gear shaft, which may be selected according to a practical situation.

(44) The driven gear **343** is engaged with the driving gear **342** and rotates with the driving gear **342**. In a practical application, the driven gear **342** and the driving gear **343** with an appropriate number of teeth may be selected according to a need. For example, the number of teeth of the driven gear **343** may be greater than the number of teeth of the driving gear **342**, such that a transmission ratio of the driving gear **342** to the driven gear **343** is greater than 1. In this way, a deceleration motion is implemented by gear transmission, thereby increasing the transmitted force to increase a torque for driving the energy conversion element **220** to swing. In addition, a driving mechanism having a larger output torque tends to have a larger volume and weight. However, the above arrangement of the gear transmission mechanism **340** may also increase the torque for driving energy conversion element **220** to swing without increasing the volume and weight of the driving mechanism **400**, thereby improving a portability of the detection probe **1000**.

(45) It should be noted that the reciprocating swing of the energy conversion element **220** is driven by the driving mechanism **400**. However, in some application scenarios, a drive direction of the output end of the driving mechanism **400** is inconsistent with the swinging direction required by the energy conversion element **220** due to factors such as structural and spatial limitations. Therefore, the transmission apparatus **300** may be designed to change a transmission direction of the force during a transmission, such that the transmission direction of the output end of the rope transmission mechanism **350** is consistent with the swinging direction required by the energy conversion element **220**. In some embodiments, a structure configured to change the transmission direction may be arranged in the gear transmission mechanism **340**, the rope transmission mechanism **350**, or both of the gear transmission mechanism **340** and the rope transmission

mechanism **350**.
(46) In some embodiments, the driving gear **342** rotates synchronously with the driving shaft **341** along a first direction under a drive of the driving mechanism **400**, and the driven gear **343** rotates with the driving gear **342** along a second direction. In some embodiments, the driven shaft **344** is inserted in a center of the driven gear **343** and rotates synchronously with the driven gear **343** along the second direction.
(47) In some embodiments, the gear transmission mechanism **340** may be arranged such that an axis of the driving shaft **341** and an axis of the driven shaft **344** form a preset angle which is greater than 0° and not greater than 90°. In other words, in this embodiment, the driving shaft **341** is not parallel to the driven shaft **344**, such that the driven gear **343** changed the transmission direction from the first direction to the second direction under a drive of the driving gear **342**.
(48) In some embodiments, the output end of the driving mechanism **400** drives the driving shaft **341** to rotate in a direction perpendicular to the swinging direction required by the energy conversion element **220**. In this case, the gear transmission mechanism **340** may be arranged such that the axis of the driving shaft **341** and the axis of the driven shaft **344** form a preset angle of 90°. In this way, the transmission direction of the driven gear **343** is perpendicular to the transmission direction of the driving gear **342** and is consistent with the swinging direction required by the energy conversion element **220** after the force is transmission through the engagement between the driving gear **342** and the driven gear **343**.
(49) In some embodiments, as shown in FIG. **8**, the driving gear **342** and the driven gear **343** may be bevel gears engaged with each other. In some embodiments, as shown in FIG. **9**, the driving gear **342** may be a face gear, and the driven gear **343** may be a cylindrical gear, providing that the two gears may change the transmission direction, which are not limited.
(50) In some embodiments, the first bearing **345** and the second bearing **346** are rotatably sleeved on a periphery of the driven shaft **344**, are spaced apart from each other, and are arranged on the first assembly position **6121** and the second assembly position **6131** respectively, such that the driven shaft **344** is arranged on the first supporting bracket **612** and the second supporting bracket **613**, and is configured to support a rotation of the driven shaft **344**.
(51) The fasten member **348** may be sleeved on the periphery of a driven shaft **344** and be arranged on one side of the driven gear **343** to cooperate with the driven shaft **344** to fix the driven gear **343**, thereby avoiding axial movement of the driven gear **343** during operation and improving a transmission stability of the gear transmission mechanism **340**. In some embodiments, the fasten member **348** may be a snap spring or other member capable of playing a role mentioned above.
(52) In some embodiments, the driven shaft **344** may be connected to the rope transmission mechanism **350** to output the force received by the driving shaft **341** to the rope transmission mechanism **350**. In some embodiments, as shown FIGS. **5** and **6**, the rope transmission mechanism **350** may include a rope wheel **351**, a rope set **352**, a tension member **353**, a rope wheel shaft, and the like.
(53) In some embodiments, the rope wheel shaft may be connected to the output end of the gear transmission mechanism **340** to receive the force from the gear transmission mechanism **340** and rotate with the gear transmission mechanism **340**. It should be noted that, in this embodiment, the rope wheel shaft is the driven shaft **344** of the gear transmission mechanism, in other words, the rope wheel shaft is the output end of the gear trans mission mechanism **340** and the input end of the rope transmission mechanism **350**.
(54) In some embodiments, the rope wheel **351** may be arranged on the periphery of the driven shaft **344** and spaced apart from the driven gear **343**. In some embodiments, the rope wheel **351** may be arranged on one side of the second supporting bracket **613** away from the first supporting bracket **612**, and may be connected to the driven shaft **344** through a flat key **354**, so as to rotate under a drive of the driven shaft **344**.
(55) In some embodiments, as shown in FIG. **10**, the rope wheel **351** may include a rope wheel

body **3511**, a shaft sleeve **3512**, and an outer flange **3513**. The rope wheel body **3511** is a body structure of the rope wheel **351**, and is sleeved on the periphery of the driven shaft **344**. The shaft sleeve **3512** is connected to one side of the rope wheel body **3511**, extends along an axial direction of the rope wheel body **3511**, and is sleeved on the periphery of the driven shaft **344**. The outer flange **3513** is arranged around a periphery of the rope wheel body **3511** and extends along the axial direction of the rope wheel body **3511**.

(56) The outer flange **3513** together with the rope wheel body **3511** and the shaft sleeve **3512** defines a receiving groove **3514** around a periphery of the shaft sleeve **3512**, and the outer flange **3513** defines a concave guide groove **3515** arranged around a periphery of the guide groove **3515**, and a gap **3516** in communication with the receiving groove **3514** and the guide groove **3515**.

(57) In some embodiments, the receiving groove **3514** may be in a shape of at least partial annular, and may be arranged on one side along the axial direction of the rope wheel body **3511**. The gap **3516** may be arranged on the rope wheel **351** close to the assembly base body **611**.

(58) In some embodiments, as shown in FIG. **11**, the tension member **353** may be arranged in the receiving groove **3514**, and may include a force applying portion **3531**, a first connection end **3532** and a second connection end **3533** respectively connected to two ends of the force applying portion **3531**. The force applying portion **3531** is sleeved on the periphery of the shaft sleeve **3512**, and may be limited by a spacer **355**, and a cheese head screw **356**, etc. The spacer **355** and the cheese head screw **356** are arranged at an end of the driven shaft **244** close to the rope wheel **351**.

(59) The rope set **352** may be arranged around the periphery of the rope wheel **351** and configured to move under a drive of the rope wheel **351**. In some embodiments, the rope set **352** may include two ropes **3521**, and first ends of the two ropes **3521** away from the tension member **353** may be respectively arranged in corresponding assembly grooves **232** of the mounting base **230** to drive the energy conversion element **220** to move through the mounting base **230**. Second ends of the two ropes **3521** away from the first ends are arranged around the guide grooves **3515** of the rope wheel **351** to move with a rotation of the rope wheel **351**. The two ropes **3521** may enter the receiving groove **3514** through a gap **3516** along the guide groove **3515**, and are connected to a first connection end **3532** and a second connection end **3533** respectively, so as to apply a pulling force along a direction away from the detection mechanism **200** to the second end of the corresponding rope **3521** under an action of the force applying part **3531**, thereby enabling the corresponding rope **3521** to be in a tension state. In this way, the rope transmission mechanism **350** drives the energy conversion element **220** to stably swing, such that the detection probe **1000** may stably scan and detect, thereby improving an accuracy of the detection result.

(60) In some embodiments, the tension member **353** may be an elastic member, such as a spring including a torsion spring or the like. The force applying portion **3531** may elastically deform to generate an elastic force to apply a pulling force to the corresponding rope **3521** through the first connection end **3532** and the second connection end **3533**, so as to enable the corresponding rope **3521** to be in the tension state.

(61) It should be noted that, in some embodiments, the tension member **353** is connected to ends of the two ropes **3521** away from the detection mechanism **200**, and is configured to apply a force to the ends, so as to enable the two ropes **3521** to be in the tension state.

(62) It should also be noted that, in some embodiments, the transmission apparatus **300** is not limited to the above structures. For example, in an application scenario, the assembly base **610** and the like in the mounting assembly **600** may also be a part of the transmission apparatus **300**. In another application scenario, the transmission apparatus **300** may also not include the shaft coupling **360** and the like, which may be arranged according to a practical situation, and is not limited.

(63) In some embodiments, as shown in FIGS. **3**, **5** and **6**, the mounting assembly **600** may include an assembly bracket **630**. The assembly bracket **630** may be arranged on one side of the assembly base body **611** away from the first supporting bracket **612** and the second supporting bracket **613**.

The driving mechanism **400** may be arranged on the assembly bracket **630**.
(64) In some embodiments, the driving mechanism **400** may be a motor, such as a stepping motor. In response to being operated, the driving mechanism **400** may output a force through the output end, and transmit the force to the gear mechanism **340** through a connection between the shaft coupling **360** and the driving shaft **341** of the gear mechanism **340**.
(65) In some embodiments, as shown in FIGS. **1** to **3**, the tail sleeve assembly **500** may include a circuit structure configured for the detection probe **1000** to work. The host **2000** may be connected to the detection mechanism **200**, the driving mechanism **400** and the like of the detection probe **1000** by connecting to the circuit in the tail sleeve assembly **500**, thereby implementing signal control and transmission of power and data.
(66) A detection probe is provided and includes a housing, a detection mechanism, a driving mechanism, and a rope transmission mechanism. The housing defines an accommodation space. The detection mechanism is arranged on one end of the housing, and is configured to perform a detection function. The driving mechanism is arranged in the accommodation space, and is configured to output a force. The rope transmission mechanism is arranged in the accommodation space, and includes a rope set and a tension member. One end of the rope set is connected to the driving mechanism, and other end of the rope set is connected to the detection mechanism. The rope set is configured to receive the force output by the driving mechanism, transmit the force to the detection mechanism, and drive the detection mechanism to move. The tension member is connected to the rope set, is configured to apply a force to one end of the rope set away from the detection mechanism and enable the rope set to be in a tension state.
(67) In some embodiments, the rope set includes two ropes, a first end of each of the ropes is connected to the detection mechanism, and the tension member includes a force applying portion, a first connection end and a second connection end. The first connection end and the second connection end are arranged on two ends of the force applying portion respectively, are connected to second ends of the two ropes respectively, are configured to apply a pulling force along a direction away from the detection mechanism to the second end of the corresponding rope under an action of the force applying portion, and are configured to enable the corresponding rope to be in the tension state.
(68) In some embodiments, the force applying portion is an elastic force applying portion configured to elastically deform to generate an elastic force, and is configured to apply the pulling force to the corresponding rope through the first connection end and the second connection end under the elastic force, and enable the corresponding rope to be in the tension state.
(69) In some embodiments, the rope transmission mechanism further includes a rope wheel shaft and a rope wheel. The rope wheel shaft is connected to the driving mechanism, and is configured to receive the force output by the driving mechanism to rotate. The rope wheel is sleeved on a periphery of the rope wheel shaft, and is configured to rotate with the rope wheel shaft. Each of the ropes is arranged around a periphery of the rope wheel and is configured to drive the detection mechanism to move with a rotation of the rope wheel. The tension member is a torsional elastic member, and the force applying portion is sleeved on the periphery of the rope wheel shaft.
(70) In some embodiments, the rope wheel includes a rope wheel body and a shaft sleeve. The rope wheel body is sleeved on the periphery of the rope wheel shaft. The shaft sleeve is connected to one side of the rope wheel body, extends along an axial direction of the rope wheel body, and is sleeved on the periphery of the rope wheel shaft. The force applying portion is sleeved on a periphery of the shaft sleeve.
(71) In some embodiments, the rope wheel further includes an outer flange. The outer flange is arranged around a periphery of the rope wheel body, extends along the axial direction of the rope wheel body, jointly define a receiving groove arranged around the periphery of the shaft sleeve with the rope wheel body and the shaft sleeve, and has a gap in communication with the receiving groove. The tension member is accommodated in the receiving groove; the second ends of the two

ropes enter the receiving groove through the gap along the periphery of the rope wheel, and are connected to the first connection end and the second connection end respectively.
(72) In some embodiments, the outer flange further defines a concave guide groove arranged around a periphery of the outer flange; the guide groove is communication with the receiving groove through the gap, and the two ropes are respectively arranged around the guide groove and enter the receiving groove through the gap to connect to the tension member.
(73) In some embodiments, the detection probe includes a gear transmission mechanism arranged in the accommodation space, connected to the driving mechanism and the rope transmission mechanism respectively, and configured to receive the force output by the driving mechanism and transmit the force to the rope transmission mechanism.
(74) In some embodiments, the gear transmission mechanism includes a driving shaft, a driving gear, a driven gear, and a driven shaft. The driving shaft is connected to the driving mechanism, and is configured to rotate under a drive of the driving mechanism. The driving gear is connected to the driving shaft, and is configured to rotate synchronously with the driving shaft. The driven gear is engaged with the driving gear, and is configured to rotate with the driving gear. The driven shaft is connected to the driven gear, is configured to rotate synchronously with the driven gear, is connected to the rope transmission mechanism, and is configured to transmit power to the rope transmission mechanism.
(75) In some embodiments, an axis of the driving shaft and an axis of the driven shaft form a preset angle, the preset angle is greater than 0° and not greater than 90°.
(76) In some embodiments, the preset angle is 90°.
(77) In some embodiments, he driving gear and the driven gear are bevel gears; or the driving gear is face gear, and the driven gear is cylindrical gear.
(78) In some embodiments, a transmission ratio of the driving gear to the driven gear is greater than 1.
(79) In some embodiments, the rope transmission mechanism further includes a rope wheel, arranged on a periphery of the driven shaft, spaced apart from the driven gear, and configured to rotate with the driven shaft. The rope set is arranged around a periphery of the rope wheel, and configured to drive the detection mechanism to move with a rotation of the rope wheel.
(80) In some embodiments, the detection probe includes an assembly base, arranged on the housing and surrounded by an inner side wall of the housing, and defining an assembly hole extending through the assembly base. One end of the driving shaft is connected to the driving gear, and other end of the driving shaft penetrates the assembly hole and is connected to the driving mechanism, and the driven shaft is rotatably arranged on the assembly base.
(81) In some embodiments, the assembly base includes: an assembly base body, arranged on the housing and surrounded by the inner side wall of the housing, and defining the assembly hole; a first supporting bracket and a second supporting bracket, respectively arranged on two sides of the assembly hole and spaced apart from each other, connected to one side of the assembly base, and respectively defining a first assembly position and a second assembly position; the gear transmission mechanism further includes a first bearing and a second bearing, the first bearing and the second bearing are arranged in the first assembly position and the second assembly position respectively, and are rotatably sleeved on a periphery of the driven shaft.
(82) In some embodiments, the detection probe includes an assembly bracket, arranged on one side of the assembly base body away from the first supporting bracket and the second supporting bracket; the driving mechanism is arranged on the assembly bracket.
(83) In some embodiments, the detection probe includes a shaft coupling, one end of the shaft coupling being connected to the driving mechanism, other end of the shaft coupling being connected to the driving shaft, and the shaft coupling being configured to transmit the force output by the driving mechanism to the driving shaft.
(84) In some embodiments, an end of the housing close to the detection mechanism defines an

opening in communication with the accommodation space, and the detection mechanism includes: an energy conversion element, configured to transmit a detection signal and receive a feedback signal carrying detection information; a supporting bracket, arranged on the housing at the opening, and including two concave arc supporting platforms; an mounting base, defining an assembly position to assemble the energy conversion element, connected to the rope set, and including two cylindrical protrusions respectively arranged on two sides of the mounting base; the two cylindrical protrusions are movably supported on corresponding concave arc supporting platforms respectively, and are configured to drive the energy conversion element to perform reciprocating swing under an action of the rope set; and an acoustic window, arranged on a periphery of the energy conversion element, the supporting bracket and the mounting base, arranged on the opening of the housing, and configured to cooperate with the energy conversion element to transmit the detection signal and receive the feedback signal.

(85) In some embodiments, assembly grooves are defined on two sides of the mounting base, the rope set includes two ropes, and ends of the two ropes away from the tension member are arranged in corresponding assembly grooves respectively.

(86) In some embodiments, the accommodation space includes an extension region and an accommodation region, and the housing includes: an insertion portion, corresponding to the extension region, at least a part of the rope transmission mechanism is accommodated in the extension region; and a holding portion, connected to one end of the insertion portion, and corresponding to the accommodation region, the driving mechanism is accommodated in the accommodation region.

(87) A transmission apparatus is provided and arranged in a detection probe including a detection mechanism and a driving mechanism, and the transmission apparatus includes a rope set, one end of the rope set being connected to the driving mechanism, other end of the rope set being connected to the detection mechanism, the rope set being configured to receive a force output by the driving mechanism, transmit the force to the detection mechanism, and drive the detection mechanism to move; and a tension member, connected to the rope set, configured to apply a force to an end of the rope set away from the detection mechanism and enable the rope set to be in a tension state.

(88) A detection device is provided and includes a host and any one of the detection probes mentioned above. The host is connected to the detection mechanism and the driving mechanism of the detection probe, and is configured to control of the driving mechanism to output a force and control the detection mechanism to perform a detection function.

(89) The above is only some embodiments of the present disclosure, but the scope of the present disclosure is not limited thereto. Within the technical scope disclosed by the present disclosure, an equivalent substitution or modification made by those skilled in the art according to the technical solutions of the present disclosure and the inventive concept thereof shall be covered by the scope of the present disclosure. Furthermore, although certain terms are used in this specification, these terms are for convenience only and do not constitute any limitation to the present disclosure.

Claims

1. A detection probe, comprising: a housing, defining an accommodation space; a detection mechanism, arranged on one end of the housing, and configured to perform a detection function; a driving mechanism, arranged in the accommodation space, and configured to output a force; and a rope transmission mechanism, arranged in the accommodation space, and comprising: a rope set, one end of the rope set being connected to the driving mechanism, other end of the rope set being connected to the detection mechanism, the rope set being configured to receive the force output by the driving mechanism, transmit the force to the detection mechanism, and drive the detection mechanism to move; and a tension member, connected to the rope set, and configured to apply a force to one end of the rope set away from the detection mechanism and enable the rope set to be in

a tension state; wherein the rope set comprises two ropes, a first end of each of the ropes is connected to the detection mechanism, and the tension member comprises: a force applying portion; and a first connection end and a second connection end, arranged on two ends of the force applying portion respectively, connected to second ends of the two ropes respectively, and configured to apply a pulling force along a direction away from the detection mechanism to the second end of the corresponding rope under an action of the force applying portion, and configured to enable the corresponding rope to be in the tension state; wherein the rope transmission mechanism further comprises: a rope wheel shaft, connected to the driving mechanism, and configured to receive the force output by the driving mechanism to rotate; and a rope wheel, sleeved on a periphery of the rope wheel shaft, and configured to rotate with the rope wheel shaft, wherein each of the ropes is arranged around a periphery of the rope wheel and is configured to drive the detection mechanism to move with a rotation of the rope wheel; wherein the rope wheel comprises: a rope wheel body, sleeved on the periphery of the rope wheel shaft; a shaft sleeve, connected to one side of the rope wheel body, extending along an axial direction of the rope wheel body, and sleeved on the periphery of the rope wheel shaft; and an outer flange, arranged around a periphery of the rope wheel body, extending along the axial direction of the rope wheel body, jointly defining a receiving groove arranged around the periphery of the shaft sleeve with the rope wheel body and the shaft sleeve, and having a gap in communication with the receiving groove; wherein the tension member is accommodated in the receiving groove; the second ends of the two ropes enter the receiving groove through the gap along the periphery of the rope wheel, and are connected to the first connection end and the second connection end respectively; wherein the outer flange further defines a concave guide groove arranged around a periphery of the outer flange; wherein the guide groove is communication with the receiving groove through the gap, and the two ropes are respectively arranged around the guide groove and enter the receiving groove through the gap to connect to the tension member.

2. The detection probe as claimed in claim 1, wherein the force applying portion is an elastic force applying portion configured to elastically deform to generate an elastic force, and is configured to apply the pulling force to the corresponding rope through the first connection end and the second connection end under the elastic force, and enable the corresponding rope to be in the tension state.

3. The detection probe as claimed in claim 1, wherein the tension member is a torsional elastic member, and the force applying portion is sleeved on the periphery of the rope wheel shaft.

4. The detection probe as claimed in claim 3, wherein the force applying portion is sleeved on a periphery of the shaft sleeve.

5. The detection probe as claimed in claim 1, further comprising: a gear transmission mechanism, arranged in the accommodation space, connected to the driving mechanism and the rope transmission mechanism respectively, and configured to receive the force output by the driving mechanism and transmit the force to the rope transmission mechanism.

6. The detection probe as claimed in claim 5, wherein the gear transmission mechanism comprises: a driving shaft, connected to the driving mechanism, and configured to rotate under a drive of the driving mechanism; a driving gear, connected to the driving shaft, and configured to rotate synchronously with the driving shaft; a driven gear, engaged with the driving gear, and configured to rotate with the driving gear; and a driven shaft, connected to the driven gear, configured to rotate synchronously with the driven gear, connected to the rope transmission mechanism, and configured to transmit power to the rope transmission mechanism.

7. The detection probe as claimed in claim 6, wherein an axis of the driving shaft and an axis of the driven shaft form a preset angle, the preset angle is greater than 0° and not greater than 90°.

8. The detection probe as claimed in claim 6, wherein the driving gear and the driven gear are bevel gears; or the driving gear is face gear, and the driven gear is cylindrical gear; or a transmission ratio of the driving gear to the driven gear is greater than 1; or the rope transmission mechanism further comprises: a rope wheel, arranged on a periphery of the driven shaft, spaced apart from the driven

gear, and configured to rotate with the driven shaft; wherein the rope set is arranged around a periphery of the rope wheel, and configured to drive the detection mechanism to move with a rotation of the rope wheel.

9. The detection probe as claimed in claim 6, further comprising: an assembly base, arranged on the housing and surrounded by an inner side wall of the housing, and defining an assembly hole extending through the assembly base; wherein one end of the driving shaft is connected to the driving gear, and other end of the driving shaft penetrates the assembly hole and is connected to the driving mechanism, and the driven shaft is rotatably arranged on the assembly base.

10. The detection probe as claimed in claim 9, wherein the assembly base comprises: an assembly base body, arranged on the housing and surrounded by the inner side wall of the housing, and defining the assembly hole; a first supporting bracket and a second supporting bracket, respectively arranged on two sides of the assembly hole and spaced apart from each other, connected to one side of the assembly base, and respectively defining a first assembly position and a second assembly position; wherein the gear transmission mechanism further comprises a first bearing and a second bearing, the first bearing and the second bearing are arranged in the first assembly position and the second assembly position respectively, and are rotatably sleeved on a periphery of the driven shaft.

11. The detection probe as claimed in claim 10, further comprising: an assembly bracket, arranged on one side of the assembly base body away from the first supporting bracket and the second supporting bracket; wherein the driving mechanism is arranged on the assembly bracket.

12. The detection probe as claimed in claim 6, further comprising: a shaft coupling, one end of the shaft coupling being connected to the driving mechanism, other end of the shaft coupling being connected to the driving shaft, and the shaft coupling being configured to transmit the force output by the driving mechanism to the driving shaft.

13. The detection probe as claimed in claim 1, wherein an end of the housing close to the detection mechanism defines an opening in communication with the accommodation space, and the detection mechanism comprises: an energy conversion element, configured to transmit a detection signal and receive a feedback signal carrying detection information; a supporting bracket, arranged on the housing at the opening, and comprising two concave arc supporting platforms; a mounting base, defining an assembly position to assemble the energy conversion element, connected to the rope set, and comprising two cylindrical protrusions respectively arranged on two sides of the mounting base; wherein the two cylindrical protrusions are movably supported on corresponding concave arc supporting platforms respectively, and are configured to drive the energy conversion element to perform reciprocating swing under an action of the rope set; and an acoustic window, arranged on a periphery of the energy conversion element, the supporting bracket and the mounting base, arranged on the opening of the housing, and configured to cooperate with the energy conversion element to transmit the detection signal and receive the feedback signal.

14. The detection probe as claimed in claim 13, wherein assembly grooves are defined on two sides of the mounting base, the rope set comprises two ropes, and ends of the two ropes away from the tension member are arranged in corresponding assembly grooves respectively.

15. The detection probe as claimed in claim 1, wherein the accommodation space comprises an extension region and an accommodation region, and the housing comprises: an insertion portion, corresponding to the extension region, wherein at least a part of the rope transmission mechanism is accommodated in the extension region; and a holding portion, connected to one end of the insertion portion, and corresponding to the accommodation region, wherein the driving mechanism is accommodated in the accommodation region.

16. A transmission apparatus, arranged in a detection probe comprising a detection mechanism and a driving mechanism, and the transmission apparatus comprising a rope transmission mechanism comprising: a rope set, one end of the rope set being connected to the driving mechanism, other end of the rope set being connected to the detection mechanism, the rope set being configured to receive a force output by the driving mechanism, transmit the force to the detection mechanism,

and drive the detection mechanism to move; and a tension member, connected to the rope set, configured to apply a force to an end of the rope set away from the detection mechanism and enable the rope set to be in a tension state; wherein the rope set comprises two ropes, a first end of each of the ropes is connected to the detection mechanism, and the tension member comprises: a force applying portion; and a first connection end and a second connection end, arranged on two ends of the force applying portion respectively, connected to second ends of the two ropes respectively, and configured to apply a pulling force along a direction away from the detection mechanism to the second end of the corresponding rope under an action of the force applying portion, and configured to enable the corresponding rope to be in the tension state; wherein the rope transmission mechanism further comprises: a rope wheel shaft, connected to the driving mechanism, and configured to receive the force output by the driving mechanism to rotate; and a rope wheel, sleeved on a periphery of the rope wheel shaft, and configured to rotate with the rope wheel shaft, wherein each of the ropes is arranged around a periphery of the rope wheel and is configured to drive the detection mechanism to move with a rotation of the rope wheel; wherein the rope wheel comprises: a rope wheel body, sleeved on the periphery of the rope wheel shaft; a shaft sleeve, connected to one side of the rope wheel body, extending along an axial direction of the rope wheel body, and sleeved on the periphery of the rope wheel shaft; and an outer flange, arranged around a periphery of the rope wheel body, extending along the axial direction of the rope wheel body, jointly defining a receiving groove arranged around the periphery of the shaft sleeve with the rope wheel body and the shaft sleeve, and having a gap in communication with the receiving groove; wherein the tension member is accommodated in the receiving groove; the second ends of the two ropes enter the receiving groove through the gap along the periphery of the rope wheel, and are connected to the first connection end and the second connection end respectively; wherein the outer flange further defines a concave guide groove arranged around a periphery of the outer flange; wherein the guide groove is communication with the receiving groove through the gap, and the two ropes are respectively arranged around the guide groove and enter the receiving groove through the gap to connect to the tension member.

17. A detection device, comprising: a host; and a detection probe comprising: a housing, defining an accommodation space; a detection mechanism, arranged on one end of the housing, and configured to perform a detection function; a driving mechanism, arranged in the accommodation space, and configured to output a force; and a rope transmission mechanism, arranged in the accommodation space, and comprising: a rope set, one end of the rope set being connected to the driving mechanism, other end of the rope set being connected to the detection mechanism, the rope set being configured to receive the force output by the driving mechanism, transmit the force to the detection mechanism, and drive the detection mechanism to move; and a tension member, connected to the rope set, and configured to apply a force to one end of the rope set away from the detection mechanism and enable the rope set to be in a tension state; wherein the host is connected to the detection mechanism and the driving mechanism of the detection probe, and is configured to control of the driving mechanism to output the force and control the detection mechanism to perform a detection function; wherein the rope set comprises two ropes, a first end of each of the ropes is connected to the detection mechanism, and the tension member comprises: a force applying portion; and a first connection end and a second connection end, arranged on two ends of the force applying portion respectively, connected to second ends of the two ropes respectively, and configured to apply a pulling force along a direction away from the detection mechanism to the second end of the corresponding rope under an action of the force applying portion, and configured to enable the corresponding rope to be in the tension state; wherein the rope transmission mechanism further comprises: a rope wheel shaft, connected to the driving mechanism, and configured to receive the force output by the driving mechanism to rotate; and a rope wheel, sleeved on a periphery of the rope wheel shaft, and configured to rotate with the rope wheel shaft, wherein each of the ropes is arranged around a periphery of the rope wheel and is configured to

drive the detection mechanism to move with a rotation of the rope wheel; wherein the rope wheel comprises: a rope wheel body, sleeved on the periphery of the rope wheel shaft; a shaft sleeve, connected to one side of the rope wheel body, extending along an axial direction of the rope wheel body, and sleeved on the periphery of the rope wheel shaft; and an outer flange, arranged around a periphery of the rope wheel body, extending along the axial direction of the rope wheel body, jointly defining a receiving groove arranged around the periphery of the shaft sleeve with the rope wheel body and the shaft sleeve, and having a gap in communication with the receiving groove; wherein the tension member is accommodated in the receiving groove; the second ends of the two ropes enter the receiving groove through the gap along the periphery of the rope wheel, and are connected to the first connection end and the second connection end respectively; wherein the outer flange further defines a concave guide groove arranged around a periphery of the outer flange; wherein the guide groove is communication with the receiving groove through the gap, and the two ropes are respectively arranged around the guide groove and enter the receiving groove through the gap to connect to the tension member.

18. The detection probe as claimed in claim 6, wherein the force applying portion is sleeved on the periphery of the shaft sleeve and is limited by a spacer and a cheese head screw, the spacer and the cheese head screw are arranged at an end of the driven shaft close to the rope wheel.

19. The transmission apparatus as claimed in claim 16, wherein the transmission apparatus further comprises: a gear transmission mechanism, arranged in a accommodation space, connected to the driving mechanism and the rope transmission mechanism respectively, and configured to receive the force output by the driving mechanism and transmit the force to the rope transmission mechanism; wherein the gear transmission mechanism comprises: a driving shaft, connected to the driving mechanism, and configured to rotate under a drive of the driving mechanism; a driving gear, connected to the driving shaft, and configured to rotate synchronously with the driving shaft; a driven gear, engaged with the driving gear, and configured to rotate with the driving gear; and a driven shaft, connected to the driven gear, configured to rotate synchronously with the driven gear, connected to the rope transmission mechanism, and configured to transmit power to the rope transmission mechanism; wherein the force applying portion is sleeved on the periphery of the shaft sleeve and is limited by a spacer and a cheese head screw, the spacer and the cheese head screw are arranged at an end of the driven shaft close to the rope wheel.

20. The detection device as claimed in claim 17, wherein the detection probe further comprises: a gear transmission mechanism, arranged in the accommodation space, connected to the driving mechanism and the rope transmission mechanism respectively, and configured to receive the force output by the driving mechanism and transmit the force to the rope transmission mechanism; wherein the gear transmission mechanism comprises: a driving shaft, connected to the driving mechanism, and configured to rotate under a drive of the driving mechanism; a driving gear, connected to the driving shaft, and configured to rotate synchronously with the driving shaft; a driven gear, engaged with the driving gear, and configured to rotate with the driving gear; and a driven shaft, connected to the driven gear, configured to rotate synchronously with the driven gear, connected to the rope transmission mechanism, and configured to transmit power to the rope transmission mechanism; wherein the force applying portion is sleeved on the periphery of the shaft sleeve and is limited by a spacer and a cheese head screw, the spacer and the cheese head screw are arranged at an end of the driven shaft close to the rope wheel.