US 20190331705A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2019/0331705 A1

Luoma (43) Pub. Date: Oct. 31, 2019

(54) **REACTION VESSEL EXCHANGER DEVICE FOR A DIAGNOSTIC ANALYZER**

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(21) Appl. No.: **16/505,529**

(22) Filed: **Jul. 8, 2019**

Related U.S. Application Data

(62) Division of application No. 15/193,990, filed on Jun. 27, 2016, now Pat. No. 10,379,130.

(60) Provisional application No. 62/185,541, filed on Jun. 26, 2015.

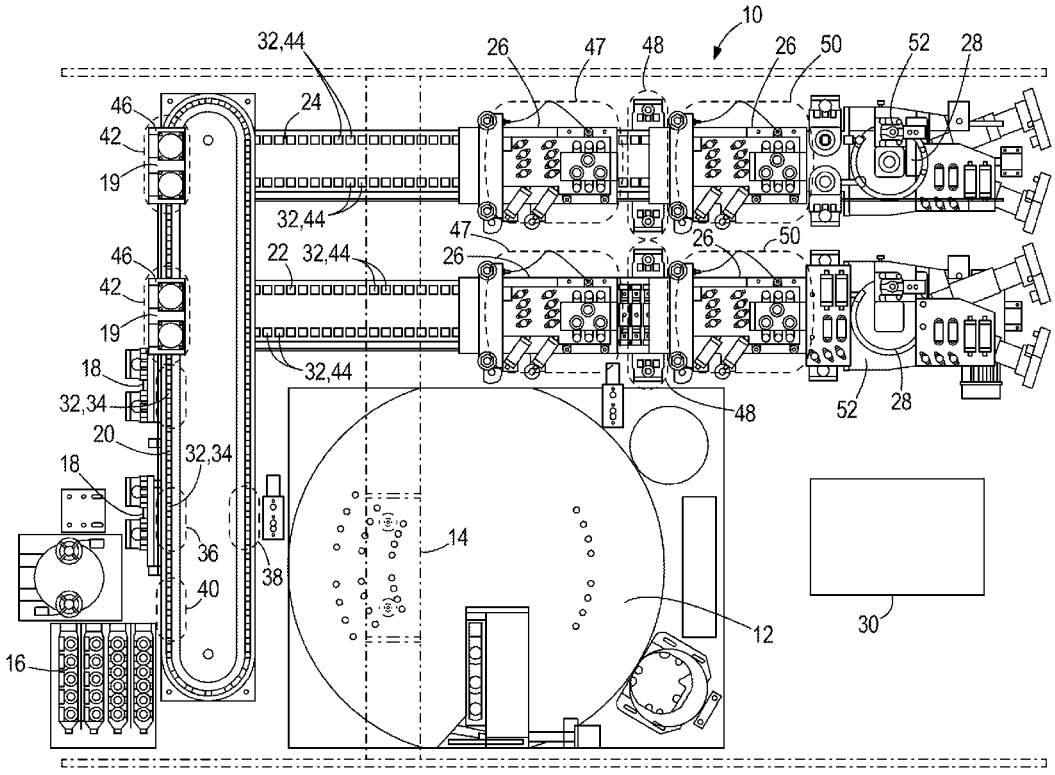
Publication Classification

(51) **Int. Cl.**
G01N 35/04 (2006.01)

(52) **U.S. Cl.**
CPC ... ***G01N 35/04*** (2013.01); *G01N 2035/00356* (2013.01)

(57) **ABSTRACT**

A diagnostic analyzer includes a first sample process path, a second sample processing path, and a reaction vessel exchanger device. The first sample process path includes an incubation track operable to move reaction vessels along the first sample process path. The second sample process path includes a processing track, disposed below the first sample process path, which is operable to move reaction vessels along the second sample process path. The reaction vessel exchanger device is configured to transfer the reaction vessels from the first sample processing path to the second sample processing path.



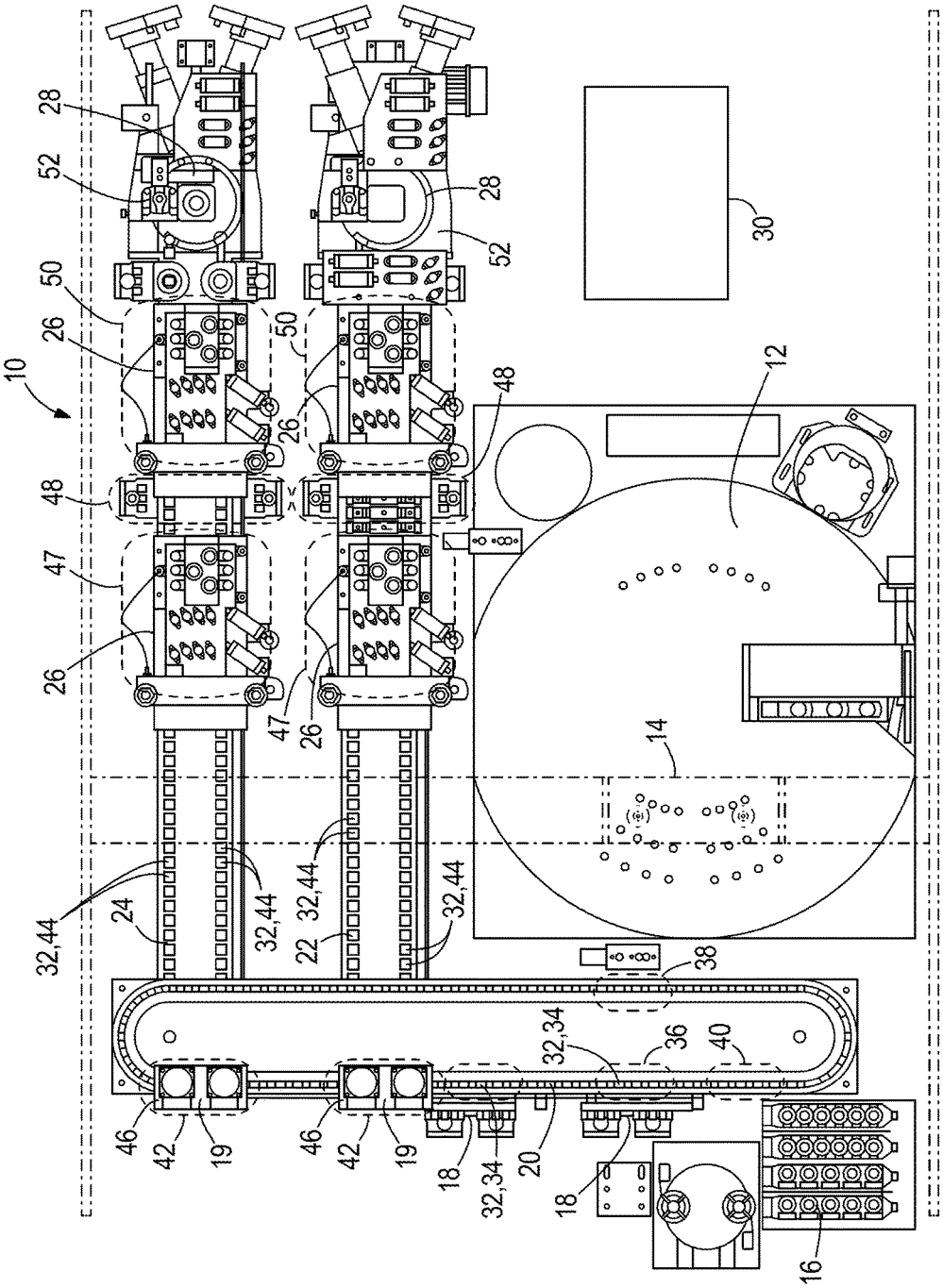

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FIG. 1

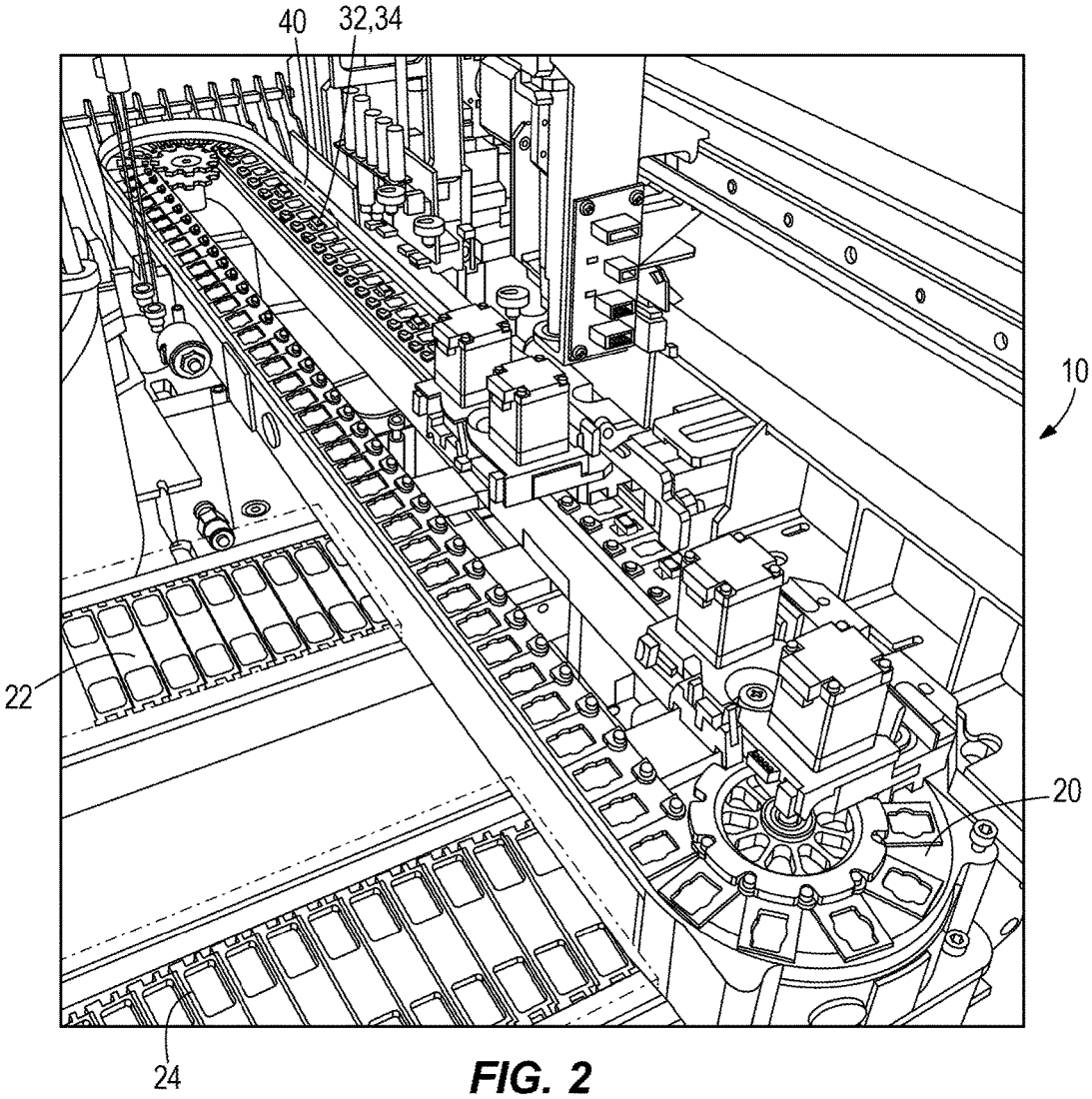


FIG. 2

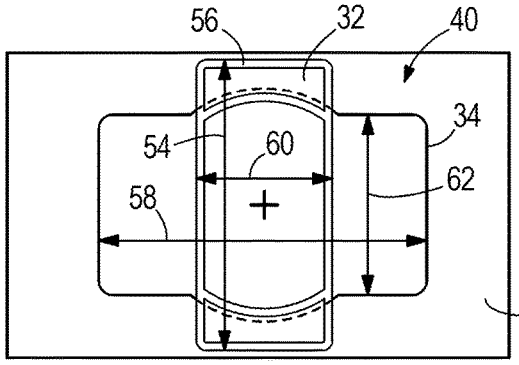


FIG. 3

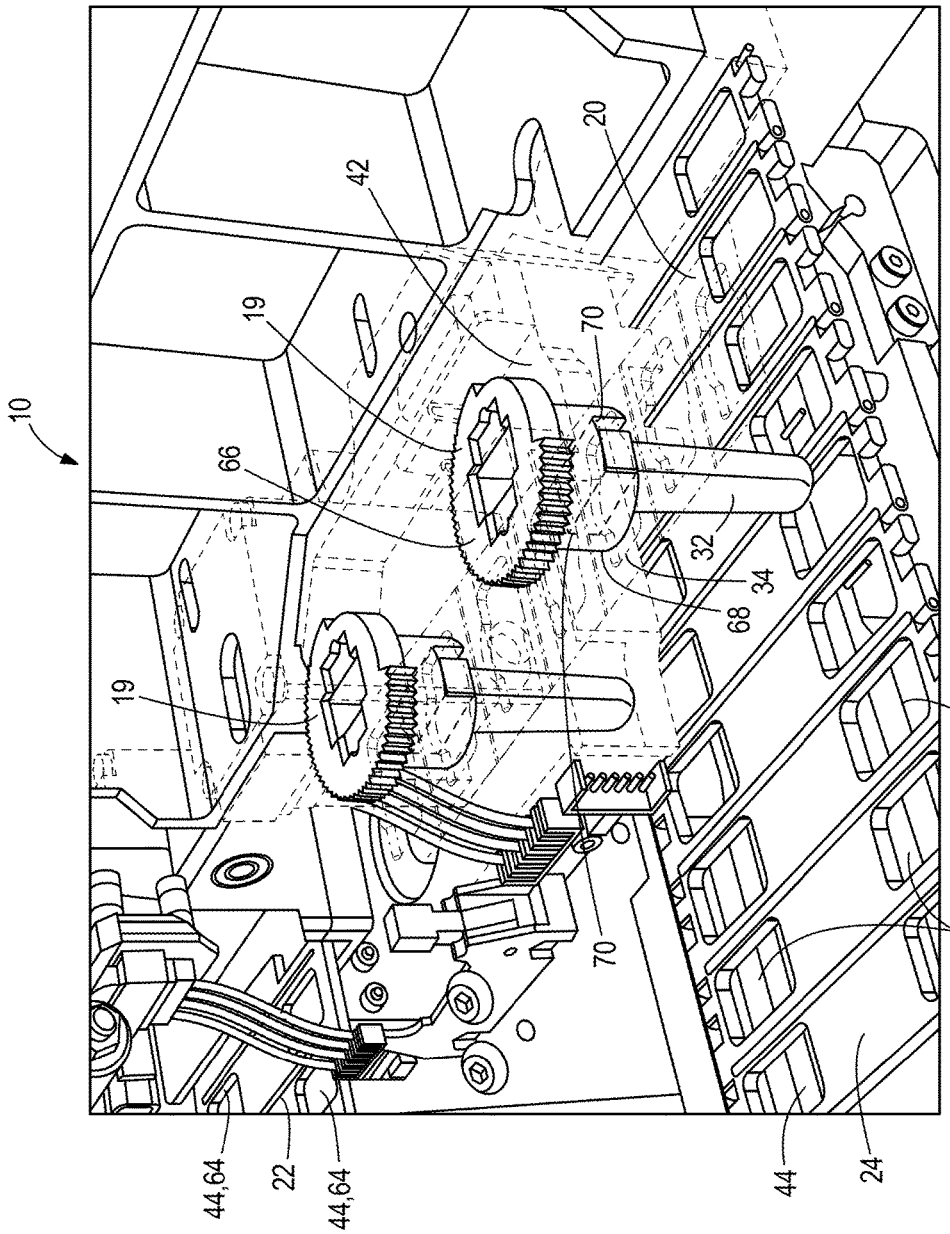


FIG. 4

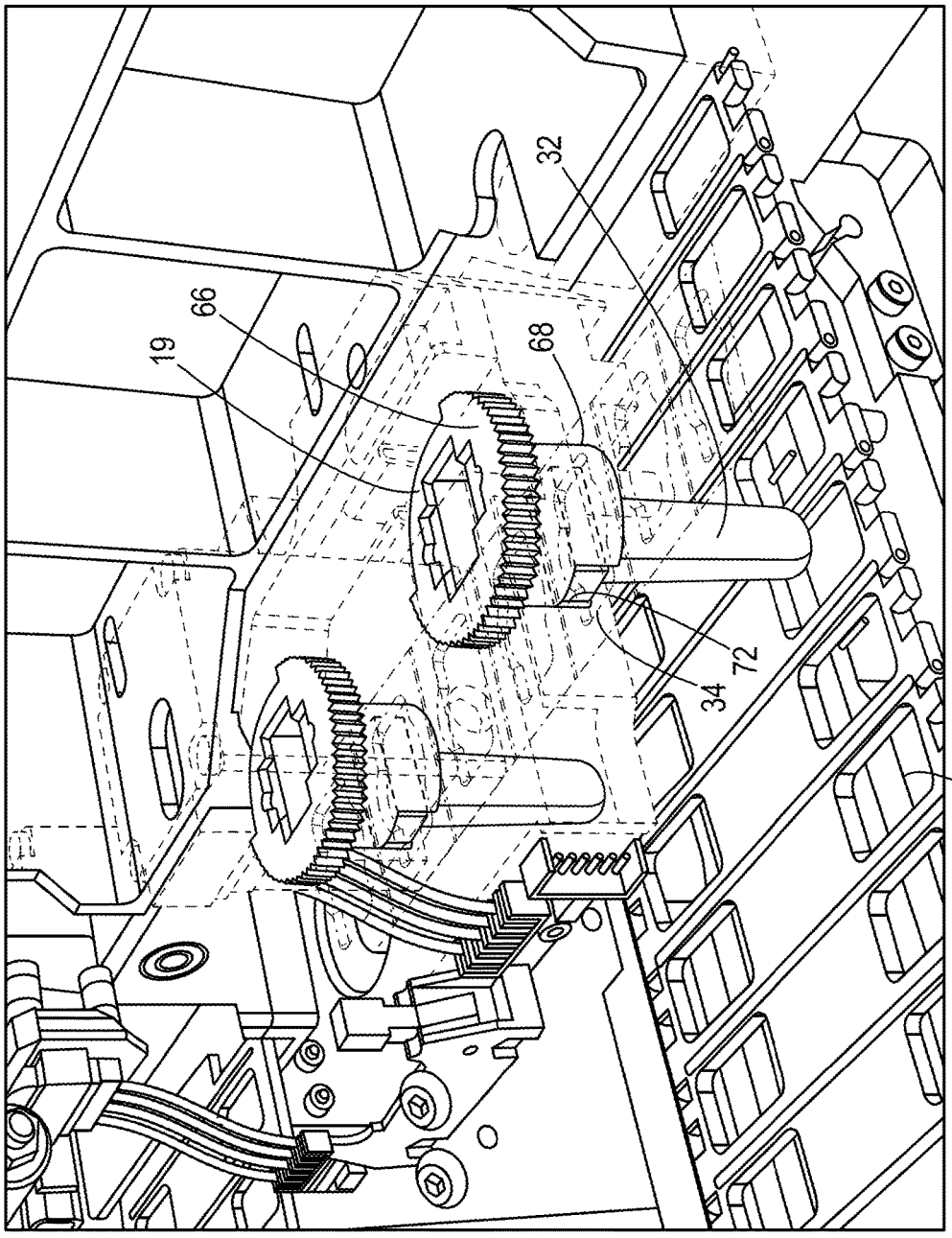


FIG. 5

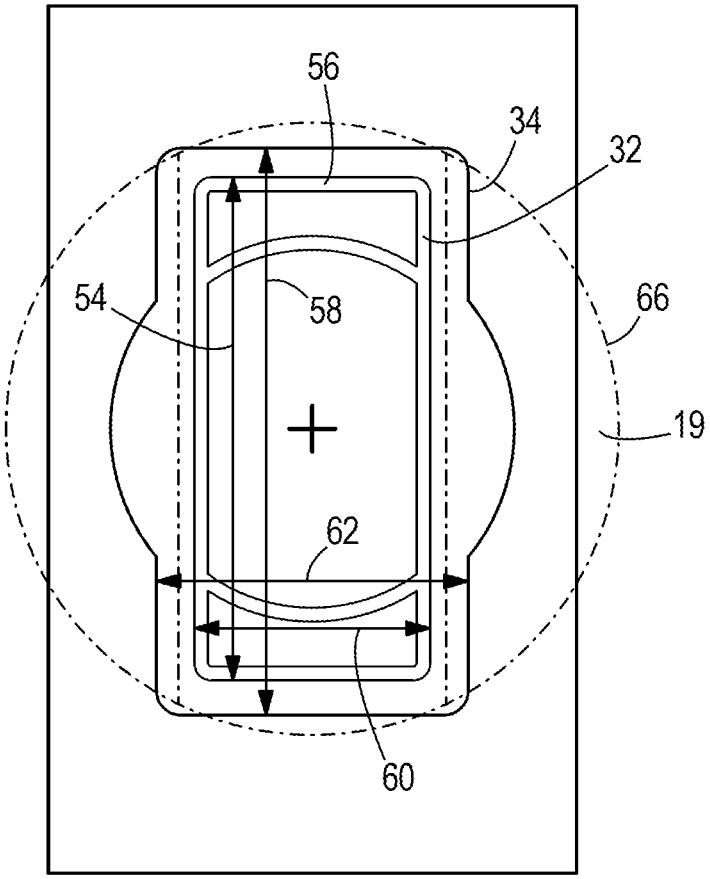


FIG. 6

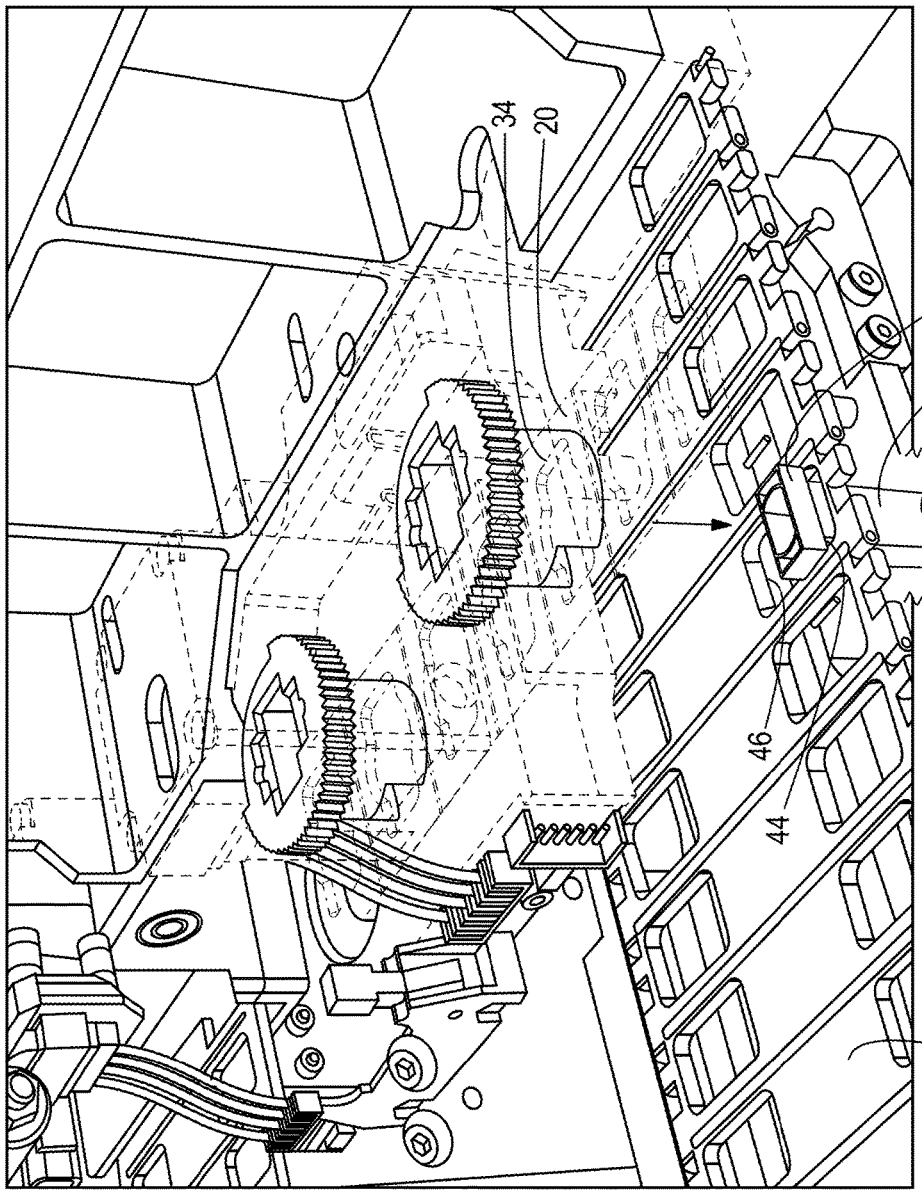


FIG. 7

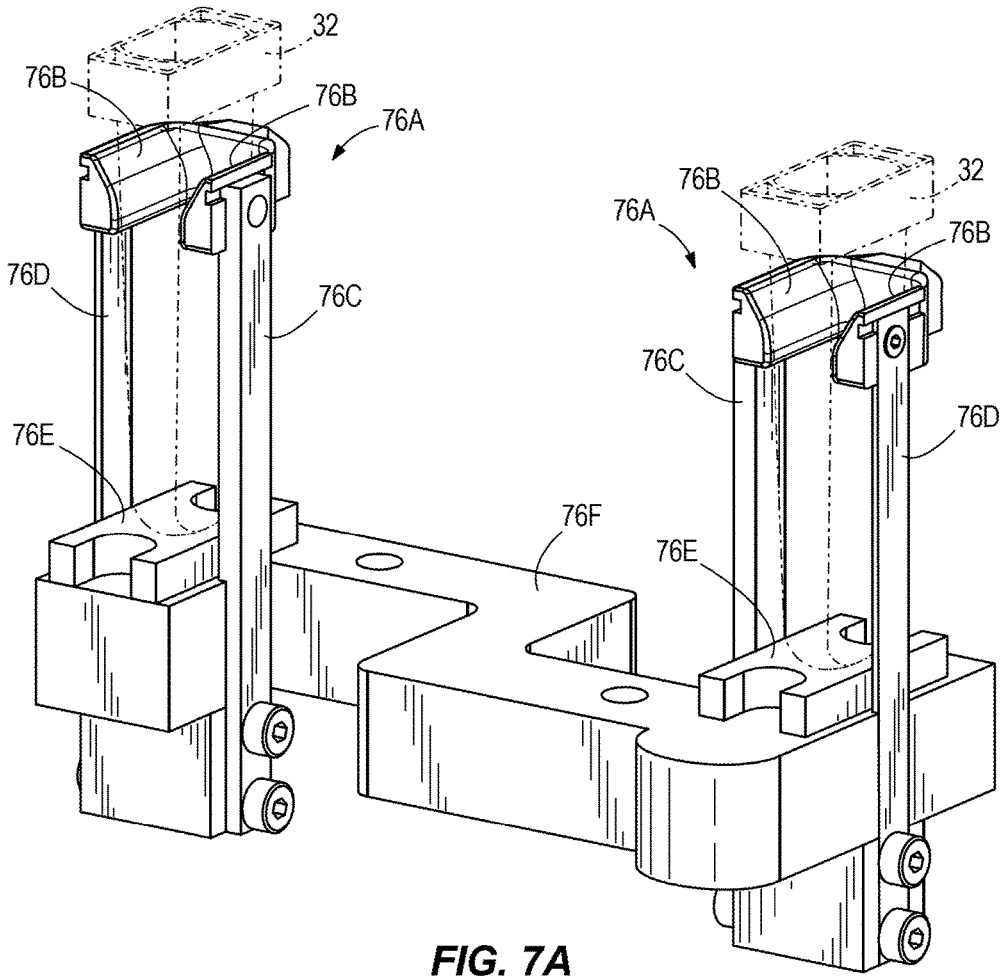


FIG. 7A

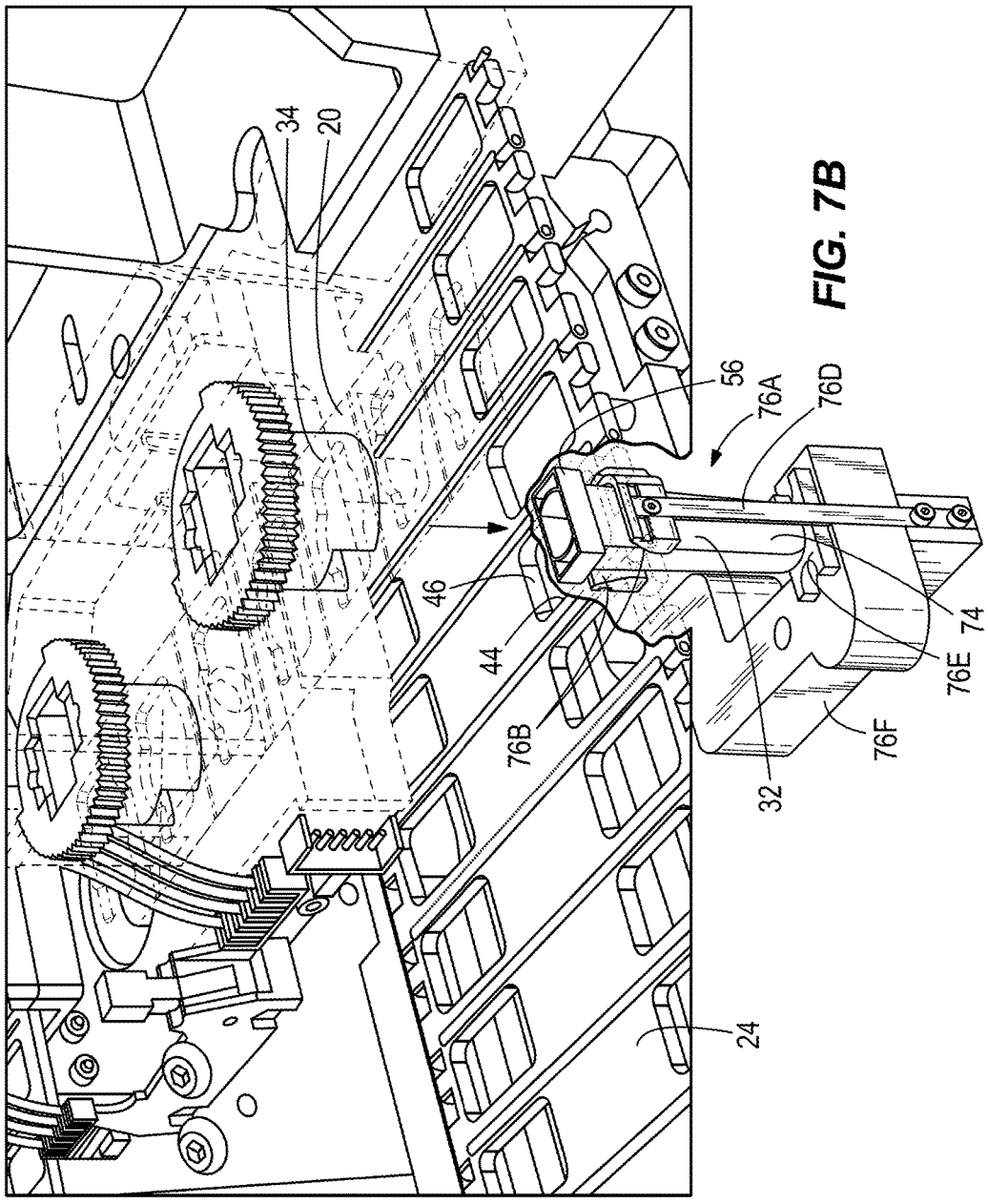


FIG. 7B

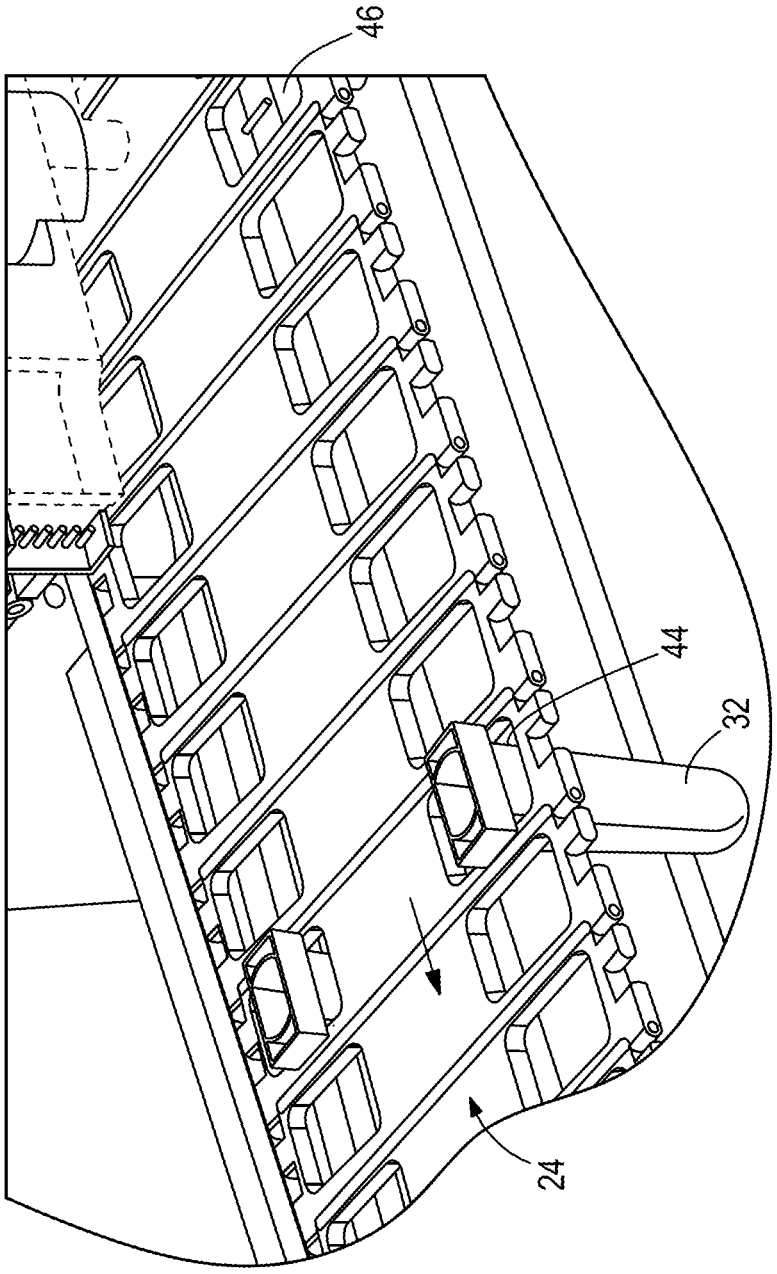


FIG. 8

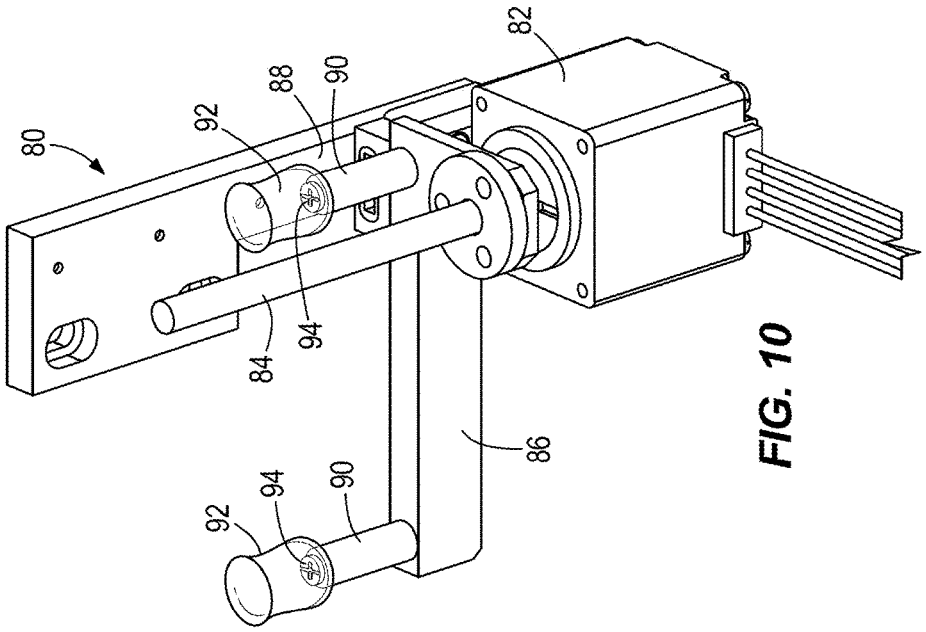


FIG. 10

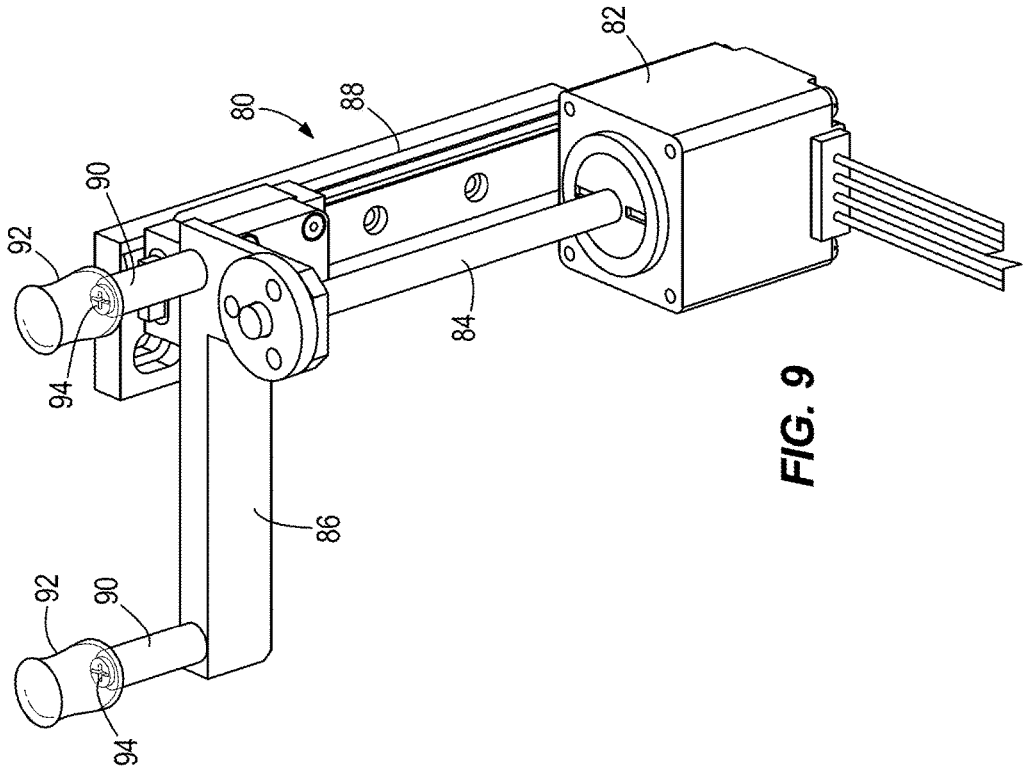


FIG. 9

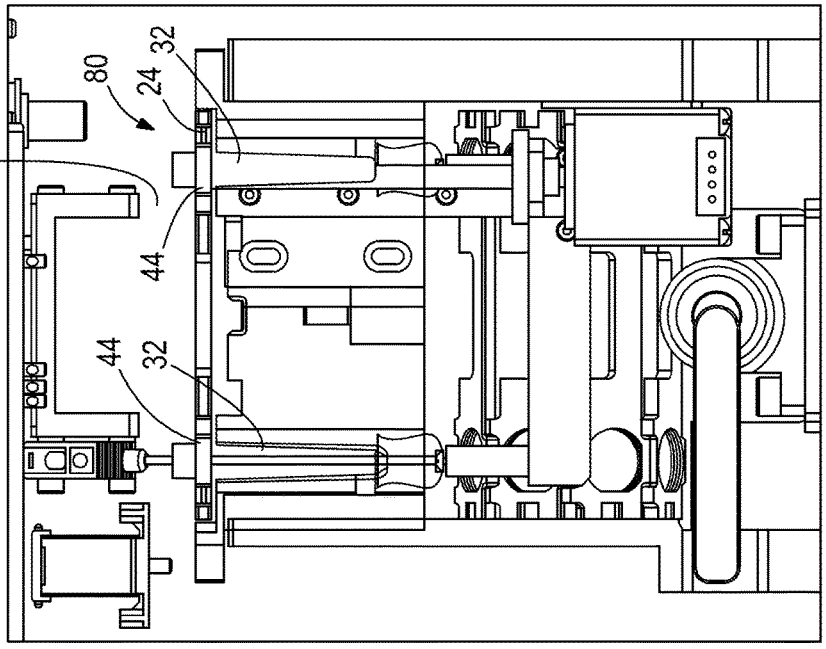


FIG. 12

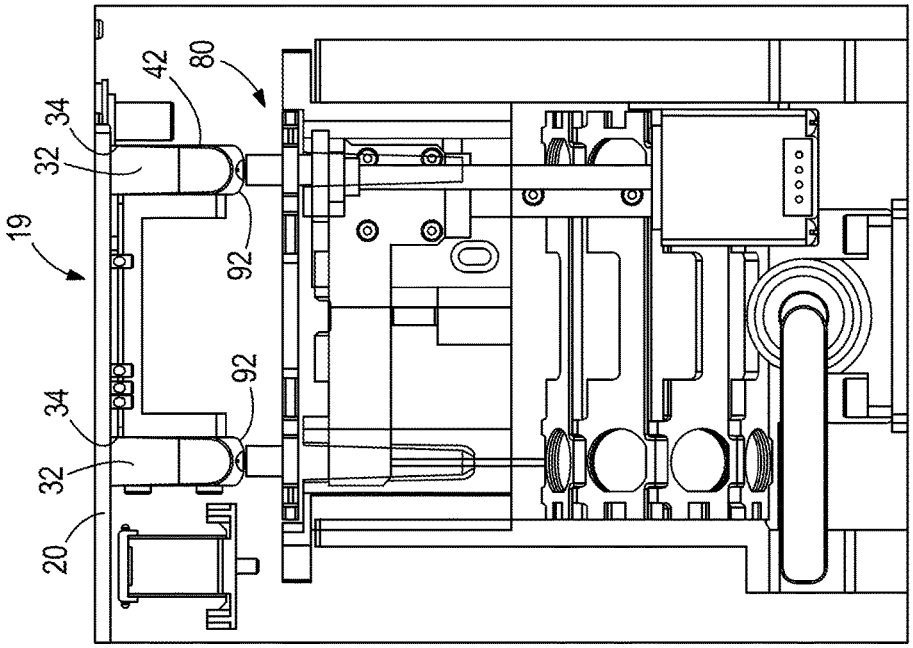


FIG. 11

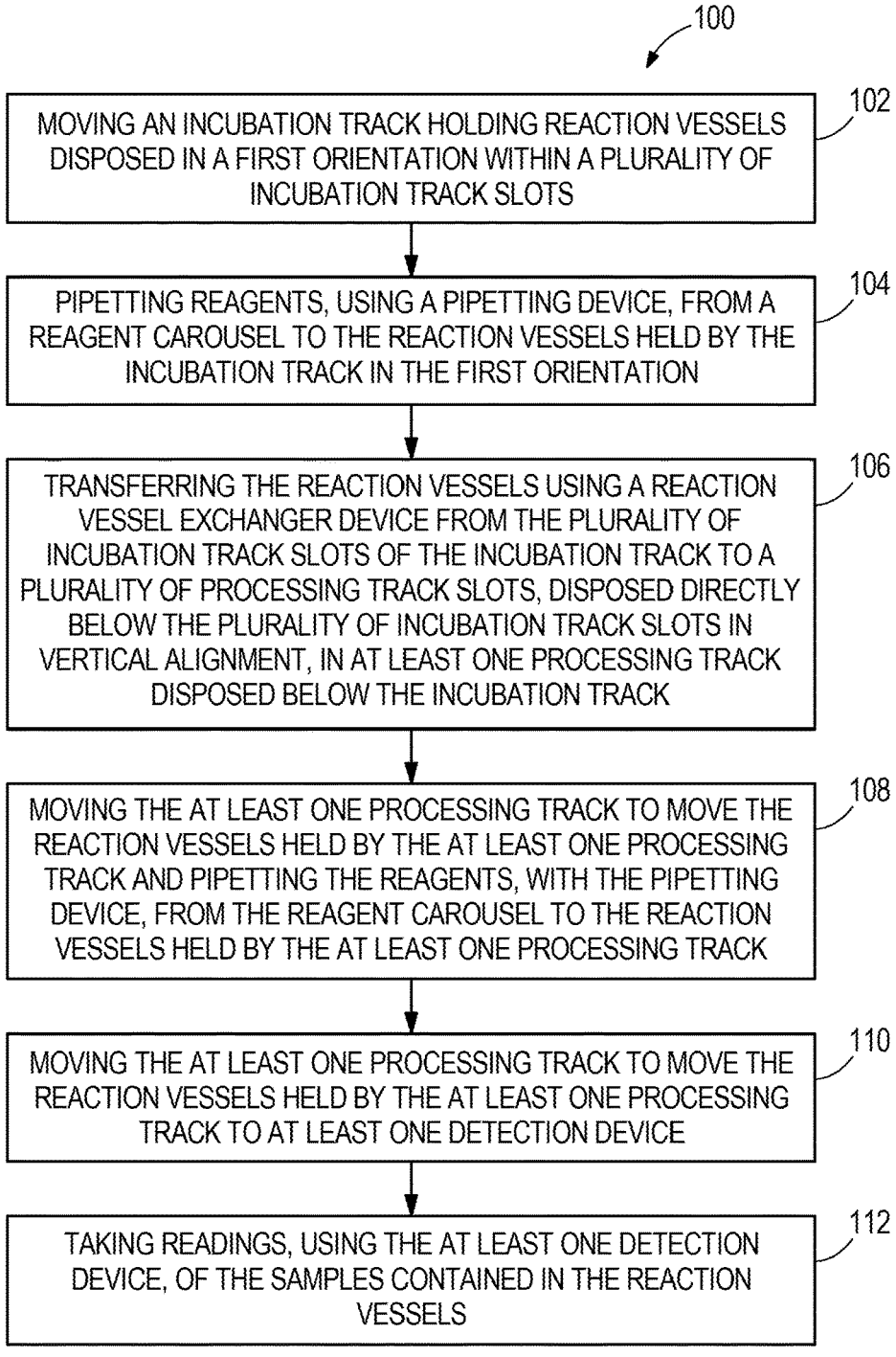

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MOVING AN INCUBATION TRACK HOLDING REACTION VESSELS DISPOSED IN A FIRST ORIENTATION WITHIN A PLURALITY OF INCUBATION TRACK SLOTS
102
PIPETTING REAGENTS, USING A PIPETTING DEVICE, FROM A REAGENT CAROUSEL TO THE REACTION VESSELS HELD BY THE INCUBATION TRACK IN THE FIRST ORIENTATION
104
TRANSFERRING THE REACTION VESSELS USING A REACTION VESSEL EXCHANGER DEVICE FROM THE PLURALITY OF INCUBATION TRACK SLOTS OF THE INCUBATION TRACK TO A PLURALITY OF PROCESSING TRACK SLOTS, DISPOSED DIRECTLY BELOW THE PLURALITY OF INCUBATION TRACK SLOTS IN VERTICAL ALIGNMENT, IN AT LEAST ONE PROCESSING TRACK DISPOSED BELOW THE INCUBATION TRACK
106
MOVING THE AT LEAST ONE PROCESSING TRACK TO MOVE THE REACTION VESSELS HELD BY THE AT LEAST ONE PROCESSING TRACK AND PIPETTING THE REAGENTS, WITH THE PIPETTING DEVICE, FROM THE REAGENT CAROUSEL TO THE REACTION VESSELS HELD BY THE AT LEAST ONE PROCESSING TRACK
108
MOVING THE AT LEAST ONE PROCESSING TRACK TO MOVE THE REACTION VESSELS HELD BY THE AT LEAST ONE PROCESSING TRACK TO AT LEAST ONE DETECTION DEVICE
110
TAKING READINGS, USING THE AT LEAST ONE DETECTION DEVICE, OF THE SAMPLES CONTAINED IN THE REACTION VESSELS
112

FIG. 13

REACTION VESSEL EXCHANGER DEVICE FOR A DIAGNOSTIC ANALYZER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional patent application of U.S. application Ser. No. 15/193,990 filed on Jun. 27, 2016 which claims the benefit of U.S. Provisional Application No. 62/185,541 filed on Jun. 26, 2015, both of which are hereby incorporated by reference in their entirety.

FIELD OF THE DISCLOSURE

[0002] This disclosure relates to a diagnostic analyzer having reactions on a plurality of proximate process paths and to a reaction vessel exchanger devices for transferring reaction vessels between process paths of a diagnostic analyzer.

BACKGROUND

[0003] Diagnostic analyzers are used to analyze samples in order to detect one or more conditions of the sample. In the past, diagnostic analyzers require multiple processing steps to be performed on a sample to perform an assay test. In some cases, the diagnostic analyzers are large and occupy significant floor space.

[0004] A diagnostic analyzer and method of use is needed to reduce or eliminate one or more issues experienced by one or more of the current diagnostic analyzers.

SUMMARY

[0005] In one embodiment, a diagnostic analyzer is disclosed. The diagnostic analyzer includes a first sample process path, a second sample processing path, and a reaction vessel exchanger device. The first sample process path includes an incubation track operable to move reaction vessels along the first sample process path. The second sample process path includes a processing track, disposed below the first sample process path, which is operable to move reaction vessels along the second sample process path. The reaction vessel exchanger device is configured to transfer the reaction vessels from the first sample processing path to the second sample processing path.

[0006] In another embodiment, a diagnostic analyzer is disclosed. The diagnostic analyzer includes an incubation track, at least one processing track, and a reaction vessel exchanger device. The incubation track is configured to move reaction vessels held by the incubation track. The at least one processing track is disposed below the incubation track in a non-parallel alignment. The reaction vessel exchanger device is configured to transfer the reaction vessels held by the incubation track to the at least one processing track. The incubation track includes a plurality of incubation track slots for holding the reaction vessels. The at least one processing track comprises a plurality of processing track slots for holding the reaction vessels. The plurality of processing track slots are disposed directly below the plurality of incubation track slots in vertical alignment.

[0007] In still another embodiment, a method of moving reaction vessels in a diagnostic analyzer is disclosed. In one step, an incubation track holding reaction vessels is moved. In another step, reagents are pipetted with a pipetting device from a reagent carousel to the reaction vessels held by the incubation track. In an additional step, the reaction vessels are transferred, using a reaction vessel exchanger device, from the incubation track to at least one processing track disposed below the incubation track. In yet another step, the reagents are pipetted with the pipetting device from the reagent carousel to the reaction vessels held by the at least one processing track.

[0008] The scope of the present disclosure is defined solely by the appended claims and is not affected by the statements within this summary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The disclosure can be better understood with reference to the following drawings and description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the disclosure.

[0010] FIG. **1** illustrates a top view of one embodiment of a diagnostic analyzer;

[0011] FIG. **2** illustrates a partial top perspective view of an incubation track and processing tracks of the diagnostic analyzer of the embodiment of FIG. **1** showing a reaction vessel in a first orientation located at one location within an incubation track slot of the incubation track;

[0012] FIG. **3** illustrates a top view showing the first orientation of the reaction vessel at the location within the incubation track slot of the incubation track;

[0013] FIG. **4** illustrates a smaller top partial perspective view of the incubation track and processing tracks of the diagnostic analyzer of the embodiment of FIG. **2** showing the reaction vessel oriented in the first orientation within the incubation track slot of the incubation track at another location within a reaction vessel exchanger device;

[0014] FIG. **5** illustrates the same top partial perspective view of the embodiment of FIG. **4** with a rotation member of the reaction vessel exchanger device having rotated ninety degrees to rotate the reaction vessel ninety degrees from the first orientation of FIG. **4** to a second orientation of FIG. **5**;

[0015] FIG. **6** illustrates a top view showing the second orientation of the reaction vessel disposed within the incubation track slot within the rotation member of the reaction vessel exchanger device;

[0016] FIG. **7** illustrates the same top partial perspective view of the embodiment of FIG. **5** with the reaction vessel having fallen through the incubation track slot of the incubation track into the processing track slot of the processing track at another location;

[0017] FIG. **7**A illustrates a perspective view of an embodiment of a dampening device which may be used in the embodiment of FIG. **7** to reduce splashing of sample and reagents within the reaction vessel as they fall through the incubation track slot of the incubation track into the processing track slot of the processing track;

[0018] FIG. **7**B illustrates the same top partial perspective view of the embodiment of FIG. **7** with the only difference being that the dampening device of FIG. **7**A has replaced a dampening device of FIG. **7**;

[0019] FIG. **8** illustrates a smaller top partial perspective view of the processing track of the embodiment of FIG. **7** being moved counter-clockwise to move the reaction vessel oriented in the second position in the processing track slot to still another location at a wash device;

[0020] FIG. **9** illustrates a top perspective view of one embodiment of a reaction vessel moving device in a raised

position which may be alternatively added into the embodiment of FIGS. **1-8** to move reaction vessels from the incubation track to the processing tracks;

[0021] FIG. **10** illustrates the same top perspective view of the embodiment of FIG. **9** of the reaction vessel moving device having been moved to a lowered position;

[0022] FIG. **11** illustrates a side cross-section view of the reaction vessel moving device of the embodiment of FIG. **9** in a raised position contacting and supporting the reaction vessels as they are disposed in incubation track slots of the incubation track within the reaction vessel exchanger device at one location;

[0023] FIG. **12** illustrates the same side cross-section view of the reaction vessel moving device of the embodiment of FIG. **11** in a lowered position having released the reaction vessels after the reaction vessels were disposed in the processing track slots of the processing track at another location; and

[0024] FIG. **13** is a flowchart illustrating one embodiment of a method of moving reaction vessels in a diagnostic analyzer.

DETAILED DESCRIPTION

[0025] FIG. **1** illustrates a top view of one embodiment of a diagnostic analyzer **10**. In one embodiment, the diagnostic analyzer **10** in part comprises a reagent carousel **12** containing one or more reagents for a diagnostic test, a pipetting device **14**, a sample supply device **16**, reaction vessel supply devices **18**, reaction vessel exchanger devices **19**, an incubation track **20** defining a first sample processing path, processing tracks **22** and **24** defining second sample processing paths, wash devices **26**, detection devices **28**, and at least one processor **30**.

[0026] The at least one processor **30** controls the reaction vessel supply devices **18** so that the supply devices **18** supply reaction vessels **32** into spaced-apart incubation track slots **34** of the incubation track **20** at locations **36**. The reaction vessels **32** are operable to contain a sample and one or more reagents for carrying out a reaction for a diagnostic analysis. In the embodiment shown in FIG. **1**, the at least one processor **30** then controls the incubation track **20** to move clockwise, causing the reaction vessels **32** residing in the incubation track **20** to advance the reaction vessels **32** to location **38**. At location **38**, the at least one processor **30** controls the pipetting device **14** to pipette reagent from the reagent carousel **12** into the reaction vessels **32** held by the incubation track **20**. Subsequently, the at least one processor **30** controls the incubation track **20** to move clockwise to location **40**. At location **40**, the at least one processor **30** controls the pipetting device **14** to pipette samples from the sample supply device **16** into the reaction vessels **32** held by the incubation track **20**. In one embodiment, the at least one processor **30** controls the incubation track **20** to move clockwise to locations **42**. In another embodiment, the at least one processor **30** controls incubation track **20** to move clockwise to cause the reaction vessels **32** to move through locations **42**, **38**, **40** and **36** again to allow the sample and reagent in the reaction vessels **32** to incubate and complete a desired reaction. In this embodiment, the reaction vessels, do not undergo additional processes at locations **36** and **38**. At locations **42**, the at least one processor **30** controls the reaction vessel exchanger devices **19** to transfer the reaction vessels **32** from the incubation track slots **34** of the incubation track **20** into spaced-apart processing track slots **44** of the processing tracks **22** and **24** at locations **46** directly below the incubation track **20**. It is noted that the processing tracks **22** and **24** are disposed below the incubation track **20** in perpendicular alignment. It is further noted that the plurality of processing track slots **44** of the processing tracks **22** and **24** are disposed below the plurality of incubation track slots **34** of the incubation track **20** in vertical alignment. In other embodiments, the configuration of the processing tracks **22** and **24** and the incubation track **20** may vary.

[0027] Subsequently, the at least one processor **30** controls the processing tracks **22** and **24** to advance the reaction vessels **32** held in the processing track slots **44** to wash devices **26** at location **47** at which point the samples contained in the reaction vessels **32** are washed. In one embodiment, the processing tracks **22** and **24** are formed as a continuous linear belt-like track that is disposed around pulleys. The pulleys may engage the processing tracks **22** and **24** in a sprocket-wheel engagement, in a friction engagement, or other forms of engagement to cause translation or movement of the processing tracks **22** and **24**. In one embodiment, a motor supplies power to one or more of the pulleys in order to rotate the pulleys. The rotation of the pulleys causes the interfaced processing tracks **22** and **24** to rotate with and around the pulleys, thereby moving the processing tracks **22** and **24** simultaneously. Next, the at least one processor **30** controls the processing tracks **22** and **24** to advance the reaction vessels **32** held in the processing track slots **44** to location **48** at which point the at least one processor **30** controls the pipetting device **14** to pipette reagent from the reagent carousel **12** into the reaction vessels **32**. Subsequently, the at least one processor **30** controls the processing tracks **22** and **24** to advance the reaction vessels **32** held in the processing track slots **44** to wash devices **26** at location **50** at which point the samples contained in the reaction vessels **32** are washed. During the washing, unbound materials of the reagents and sample are washed away from magnetically bound materials. Finally, the at least one processor **30** controls the processing tracks **22** and **24** to advance the reaction vessels **32** held in the processing track slots **44** to detection devices **28** at locations **52** at which point the detection devices **28** take readings of the samples contained in the reaction vessels **32**.

[0028] FIG. **2** illustrates a partial top perspective view of the incubation track **20** and the processing tracks **22** and **24** of the diagnostic analyzer **10** of the embodiment of FIG. **1** showing a reaction vessel **32** in a first orientation located at location **40** within an incubation track slot **34** of the incubation track **20** as described above. FIG. **3** illustrates a top view showing the first orientation of the reaction vessel **32** at location **40** within the incubation track slot **34** of the incubation track **20**. It is noted that all of the reaction vessels **32** are oriented in this first orientation within and relative to the incubation track slots **34** from the time when they are supplied into the incubation track slots **34** at location **36** (shown in FIG. **1**) up until the time they are delivered to location **42** (shown in FIG. **1**) within the reaction vessel exchanger devices **19**.

[0029] As shown in FIG. **3**, when the reaction vessel **32** is disposed in the first orientation, the length **54** of the top ledge **56** of the reaction vessel **32** is disposed perpendicular to the length **58** of the incubation track slot **34** and the width **60** of the top ledge **56** of the reaction vessel **32** is disposed perpendicular to the width **62** of the incubation track slot **34**.

The length **54** of the top ledge **56** of the reaction vessel **32** is longer than the width **60** of the top ledge **56** of the reaction vessel **32**. The length **58** of the incubation track slot **34** is greater than both the length **54** and the width **60** of the top ledge **56** of the reaction vessel **32**. The width **62** of the incubation track slot **34** is larger than the width **60** of the top ledge **56** of the reaction vessel **32** but smaller than the length **54** of the top ledge **56** of the reaction vessel **32**. When the reaction vessel **32** is disposed in the first orientation the reaction vessel **32** is held in place within the incubation track slot **34** of the incubation track **20** because the length **54** of the top ledge **56** of the reaction vessel **32** is greater than the width **62** of the incubation track slot **34**. As a result, the top ledge **56** of the reaction vessel **32** rests in place on top of the incubation track slot **34** while a bottom portion (not shown) of the reaction vessel **32** is disposed through the incubation track slot **34** as a result of its size being smaller than the incubation track slot **34**.

[0030] FIG. **4** illustrates a smaller top partial perspective view of the incubation track **20** and processing tracks **22** and **24** of the diagnostic analyzer **10** of the embodiment of FIG. **2** showing the reaction vessel **32** oriented in the first orientation within the incubation track slot **34** of the incubation track **20** at location **42** within reaction vessel exchanger device **19**. It is noted that there are two reaction vessel exchanger devices **19** located over each of the processing tracks **22** and **24**. Each of the processing tracks **22** and **24** contain two lanes **64** of the processing track slots **44**. A separate reaction vessel exchanger device **19** is located over each lane **64** of the processing track slots **44** of each of the processing tracks **22** and **24** (see also FIG. **1**). Each of the separate reaction vessel exchanger devices **19** are configured to transfer reaction vessels **32**, one at a time, from the incubation track slots **34** of the incubation track **20** to its assigned lane **64** of processing track slots **44**.

[0031] Each reaction vessel exchanger device **19** comprises a rotation member **66** to rotate a reaction vessel **32**, as it is held by an incubation track slot **34** of the incubation track **20**, from the first orientation to a second orientation. The rotation member **66** comprises an open-ended shaft **68** having opposed slots **70**. The opposed slots **70** are sized to allow the reaction vessels **32** to pass through the opposed slots **70**. When the incubation track **20** moves a reaction vessel **32** to location **42** the reaction vessel **32** passes through one of the opposed slots **70** into the open-ended shaft **68** of the rotation member **66** between the opposed slots **70**.

[0032] FIG. **5** illustrates the same top partial perspective view of the embodiment of FIG. **4** with the rotation member **66** of the reaction vessel exchanger device **19** having rotated ninety degrees to rotate the reaction vessel **32** ninety degrees from the first orientation of FIG. **4** to the second orientation of FIG. **5**. The at least one processor **30** (shown in FIG. **1**) caused the rotation member **66** of the reaction vessel exchanger device **19** to rotate. During this rotation, an inner shaft wall **72** of the opened-ended shaft **68** abutted against the reaction vessel **32** forcing it to rotate with the rotation member **66** from the first orientation of FIG. **4** to the second orientation of FIG. **5**.

[0033] FIG. **6** illustrates a top view showing the second orientation of the reaction vessel **32** disposed within the incubation track slot **34** within the rotation member **66** of the reaction vessel exchanger device **19**. As shown in FIG. **6**, when the reaction vessel **32** is disposed in the second orientation the length **54** of the top ledge **56** of the reaction vessel **32** is disposed parallel to the length **58** of the incubation track slot **34** and the width **60** of the top ledge **56** of the reaction vessel **32** is disposed parallel to the width **62** of the incubation track slot **34**. Because the length **58** of the incubation track slot **34** is greater than the length **54** of the top ledge **56** of the reaction vessel **32** and the width **62** of the incubation track slot **34** is greater than the width **60** of the top ledge **56** of the reaction vessel **32**, the reaction vessel **32** may pass through the incubation track slot **34** towards the processing track slot **44** (shown in FIG. **5**) which is disposed in vertical alignment directly below the incubation track slot **34**. In one embodiment, the reaction vessel **32** is passed through the incubation track slot **34** towards the processing track slot **44** by falling through the incubation track slot **34** by gravitational force.

[0034] FIG. **7** illustrates the same top partial perspective view of the embodiment of FIG. **5** with the reaction vessel **32** having passed through the incubation track slot **34** of the incubation track **20** into the processing track slot **44** of the processing track **24** at location **46**. The reaction vessel **32** has retained its second orientation and has landed within the processing track slot **44** with the size of the processing track slot **44** configured to hold the top ledge **56** of the reaction vessel **32** in place and prevent the top ledge **56** of the reaction vessel **32** from falling through the processing track slot **44**. The bottom portion **74** of the reaction vessel **32** is disposed through the processing track slot **44** as a result of its size being smaller than the processing track slot **44**. In one embodiment, the fall of the bottom portion **74** of the reaction vessel **32** through the processing track slot **44** was dampened by a dampening device **76** disposed below the processing track slot **44** to reduce splashing of the sample and reagents contained within the reaction vessel **32**. In one embodiment, the dampening device **76** comprises a pillow. In other embodiments, the dampening device **76** may comprise a spring, a flexible member or any other type of dampening device for dampening the fall of the reaction vessel **32** through the processing track slot **44**.

[0035] FIG. **7**A illustrates a perspective view of another embodiment of a dampening device **76**A. The dampening device **76**A may replace the dampening device **76** of FIG. **7** to further reduce or eliminate splashing of the sample and reagents contained within the reaction vessel **32**. The dampening device **76**A comprises low friction guides **76**B, support members **76**C, damping springs **76**D, pads **76**E, and base **76**F. The low friction guides **76**B are sized to apply a small amount of friction on the reaction vessels **32** as the reaction vessels **32** slide through the low friction guides **76**B to reduce the amount of impact when the reaction vessels **32** contact the pads **76**E thereby reducing splashing of the sample and reagents within the reaction vessels **32**. The support members **76**C are attached to and fixed in place between the low friction guides **76**B and the base **76**F holding the low friction guides **76**B above the base **76**F. The damping springs **76**D are also attached to and fixed in place between the low friction guides **76**B and the base **76**F holding the low friction guides **76**B above the base **76**F. The damping springs **76**D are made of a spring like material to provide some springiness to the low friction guides **76**B. The pads **76**E are made of a flexible material such as rubber. In other embodiments, the configuration, size, shape, orientation, and material of the dampening device **76**A may vary.

[0036] FIG. **7**B illustrates the same top partial perspective view of the embodiment of FIG. **7** with the only difference

being that the dampening device **76**A of FIG. **7**A has replaced the dampening device **76** of FIG. **7**. As shown, the reaction vessel **32** has passed through the incubation track slot **34** of the incubation track **20** into the processing track slot **44** of the processing track **24** at location **46**. The reaction vessel **32** has retained its second orientation and has landed within the processing track slot **44** with the size of the processing track slot **44** configured to hold the top ledge **56** of the reaction vessel **32** in place and prevent the top ledge **56** of the reaction vessel **32** from falling through the processing track slot **44**. The bottom portion **74** of the reaction vessel **32** is disposed through the processing track slot **44** as a result of its size being smaller than the processing track slot **44**. The fall of the bottom portion **74** of the reaction vessel **32** through the processing track slot **44** was dampened by the dampening device **76**A disposed below the processing track slot **44** to reduce splashing of the sample and reagents contained within the reaction vessel **32**. The low friction guides **76**B applied a small amount of friction on the reaction vessel **32** as the reaction vessel **32** slid through the low friction guide **76**B thereby reducing the amount of impact when the reaction vessel **32** contacted the pad **76**E and in-turn reducing splashing of the sample and reagents within the reaction vessel **32**.

[0037] FIG. **8** illustrates a smaller top partial perspective view of the processing track **24** of the embodiment of FIG. **7** being moved counter-clockwise, as controlled by the at least one processor **30** (shown in FIG. **1**), to move the reaction vessel **32** oriented in the second position in the processing track slot **44** from location **46** towards the wash device **26** (shown in FIG. **1**) located at location **47** (shown in FIG. **1**). As previously discussed with respect to FIG. **1**, after the wash device **26** washes the sample contained in the reaction vessel **32** at location **47**, the at least one processor **30** controls the processing track **24** to move the processing track **24** to advance the reaction vessel **32** oriented in the second position in the processing track slot from location **47** to location **48** at which point the at least one processor **30** controls the pipetting device **14** to pipette reagent from the reagent carousel **12** into the reaction vessel **32**. As previously discussed with respect to FIG. **1**, after the pipetting device **14** pipettes reagent into the reaction vessel **32** at location **48**, the at least one processor **30** controls the processing track **24** to move it counter-clockwise to move the reaction vessel **32** oriented in the second position in the processing track slot **44** to the wash device **26** at location **50**. As previously discussed with respect to FIG. **1**, after the wash device **26** washes the sample contained in the reaction vessel **32** at location **50**, the at least one processor **30** controls the processing track **24** to move it counter-clockwise to move the reaction vessel **32** oriented in the second position in the processing track slot **44** from location **50** to location **52** at which point the detection device **28** takes a reading of the sample contained in the reaction vessel **32**.

[0038] Although FIGS. **2-8** only show the movement of one reaction vessel **32** between the various locations, it is noted that all of the reaction vessels **32** are moved in the same manner between the various locations assisted by the reaction vessel exchanger devices **19** transferring the reaction vessels **32** from the incubation track **20** to the lanes **64** of the processing tracks **22** and **24** as discussed above with respect to FIG. **4**. In other embodiments, the components of the diagnostic analyzer **10** may vary, the components of the diagnostic analyzer **10** may be oriented or configured in different locations, or one or more additional components may be added to the diagnostic analyzer **10**.

[0039] FIG. **9** illustrates a top perspective view of one embodiment of a reaction vessel moving device **80** in a raised position which may be alternatively added into the embodiment of FIGS. **1-8** to engage and move reaction vessels **32** from the incubation track **20** to the processing tracks **22** and **24** to avoid or limit splashing of the sample and reagents within the reaction vessels **32**. The reaction vessel moving device **80** comprises a motor **82**, a shaft **84**, a plate **86**, a linear guide **88**, posts **90**, moving devices **92**, and screws or bearings **94**. The motor **82** is configured to raise and lower the shaft **84** and the attached plate **86**. Since the plate **86** is attached to the posts **90** which are attached to the moving devices **92**, this movement also raises and lowers these components. The linear guide **88** forces the components to travel linearly in a vertical up and down direction. The screws or bearings **94** allow the moving devices **92** to rotate. In one embodiment, the moving devices **92** comprise tulip shapes made of a flexible, elastomeric material which are sized and shaped to fit over and latch onto a reaction vessel **32** (collectively shown in FIGS. **1-8**) when the moving devices **92** are located in the raised position of FIG. **9** and to release the reaction vessel **32** when the moving devices **92** are lowered to the lowered position of FIG. **10**. In other embodiments, the moving devices **92** may vary in shape, size, configuration, orientation, and material. For instance, in another embodiment the moving devices **92** may be configured, sized, and shaped to merely contact and support the reaction vessel **32** in the raised position of FIG. **9**, without latching onto the reaction vessel **32**, and may move the reaction vessel **32** to the lowered position of FIG. **10**

[0040] FIG. **10** illustrates the same top perspective view of the embodiment of FIG. **9** of the reaction vessel moving device **80** having been moved to a lowered position. FIG. **11** illustrates a side cross-section view of the reaction vessel moving device **80** of the embodiment of FIG. **9** in a raised position engaging the reaction vessels **32** at location **42** as they are disposed in incubation track slots **34** of the incubation track **20** within the reaction vessel exchanger device **19**. As the reaction vessel exchanger device **19** rotates the reaction vessels **32** from their first position to their second position the moving devices **92** rotate with the reaction vessels **32** which are disposed within the moving devices **92**. FIG. **12** illustrates the same side cross-section view of the reaction vessel moving device **80** of the embodiment of FIG. **11** in a lowered position having released the reaction vessels **32** after the reaction vessels **32** were disposed in the processing track slots **44** of the processing track **24** at location **46**. In other embodiments, the reaction vessel moving device **80** may vary in size, configuration, orientation, location, material, or function.

[0041] FIG. **13** is a flowchart illustrating one embodiment of a method **100** of moving reaction vessels in a diagnostic analyzer. The method **100** may utilize any of the diagnostic analyzers disclosed herein. In other embodiments, the method **100** may utilize varying diagnostic analyzers. In step **102**, an incubation track holding reaction vessels disposed in a first orientation within a plurality of incubation track slots is moved. In step **104**, reagents are pipetted, using a pipetting device, from a reagent carousel to the reaction vessels held by the incubation track in the first orientation. In step **106**, the reaction vessels are transferred using a

reaction vessel exchanger device from the plurality of incubation track slots of the incubation track to a plurality of processing track slots, disposed directly below the plurality of incubation track slots in vertical alignment, in at least one processing track disposed below the incubation track.

[0042] In one embodiment, step **106** comprises the reaction vessels passing through a slot of an open-ended shaft and an inner shaft wall of an open-ended shaft of a rotation member abutting against the reaction vessels to rotate the reaction vessels from the first orientation within the incubation track slots to a second orientation within the incubation track slots so that the reaction vessels pass through the incubation track slots into the processing track slots. In another embodiment, step **106** comprises gravity causing the reaction vessels to pass through the plurality of incubation track slots of the incubation track into the processing track slots of the processing tracks. In yet another embodiment, step **106** comprises a reaction vessel moving device contacting and supporting the reaction vessels and moving the reaction vessels through the incubation track slots into the processing track slots. The reaction vessel moving device may comprise a flexible member fitting over and against the reaction vessels. In other embodiments, the reaction vessel moving device may vary in form and function. In still another embodiment, step **106** comprises dampening movement of the reaction vessels as they move into the processing track slots with a dampening device disposed below the processing track slots. The dampening device may comprise a pillow, a flexible member such as a spring, a low friction guide, or another type of dampening member.

[0043] In step **108**, the at least one processing track is moved to move the reaction vessels held by the at least one processing track and the reagents are pipetted, with the pipetting device, from the reagent carousel to the reaction vessels held by the at least one processing track. In step **110**, the at least one processing track is moved to move the reaction vessels held by the at least one processing track to at least one detection device. In step **112**, readings are taken, using the at least one detection device, of the samples contained in the reaction vessels. In still other embodiments, one or more steps of the method **100** may be varied in substance or order, one or more steps may not be followed, or one or more steps may be added.

[0044] One or more embodiments of the disclosure reduces cost and maintenance, and saves space over one or more of the existing diagnostic analyzers due to the use of the shared pipetting device and reagent carousel, and the use of the efficient reaction vessel exchanger device to transfer reaction vessels. Still other issues associated with one or more additional existing diagnostic analyzers may be reduced or overcome using one or more embodiments of the disclosure.

[0045] The Abstract is provided to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in various embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separately claimed subject matter.

[0046] While particular aspects of the present subject matter described herein have been shown and described, it will be apparent to those skilled in the art that, based upon the teachings herein, changes and modifications may be made without departing from the subject matter described herein and its broader aspects and, therefore, the appended claims are to encompass within their scope all such changes and modifications as are within the true scope of the subject matter described herein. Furthermore, it is to be understood that the disclosure is defined by the appended claims. Accordingly, the disclosure is not to be restricted except in light of the appended claims and their equivalents.

1. A method of moving reaction vessels in a diagnostic analyzer comprising:

moving an incubation track holding reaction vessels;

pipetting reagents or samples, with a pipetting device, into the reaction vessels held by the incubation track

transferring the reaction vessels, using a reaction vessel exchanger device, from the incubation track to at least one processing track disposed below the incubation track by rotating the reaction vessels, as they are held by incubation track slots of the incubation track in a first orientation, to a second orientation so that the reaction vessels pass through the incubation track slots into processing track slots of the at least one processing track; and

taking readings of the samples contained in the reaction vessels with at least one detection device.

2. The method of claim **1** wherein the plurality of processing track slots are disposed directly below the plurality of incubation track slots in vertical alignment.

3. The method of claim **1** further comprising moving the at least one processing track to move the reaction vessels held by the processing track slots of the at least one processing track to the at least one detection device.

4. The method of claim **1** wherein the incubation track and the at least one processing track each separately comprise a continuous linear belt-like track disposed around pulleys.

5. The method of claim **4** wherein a first longitudinal axis of the incubation track is disposed perpendicular to a second longitudinal axis of the at least one processing track.

6. The method of claim **1** wherein the reaction vessel exchanger device rotating the reaction vessels from the first orientation within the incubation track slots to the second orientation comprises the reaction vessels passing through a slot of an open-ended shaft and an inner shaft wall of the open-ended shaft abutting against the reaction vessels to rotate the reaction vessels from the first orientation to the second orientation.

7. The method of claim **1** further comprising a reaction vessel moving device contacting and supporting the reaction vessels and moving them through the incubation track slots into the processing track slots.

8. The method of claim **7** wherein the reaction vessel moving device contacting and supporting the reaction vessels in the second orientation comprises a flexible member fitting over and against the reaction vessels.

9. The method of claim **1** further comprising dampening movement of the reaction vessels as they move into the processing track slots with a dampening device disposed below the processing track slots.

10. A method of moving reaction vessels in a diagnostic analyzer comprising:

moving an incubation track holding reaction vessels;

pipetting reagents, with a pipetting device, from a reagent carousel to the reaction vessels held by the incubation track

transferring the reaction vessels, using a reaction vessel exchanger device, from the incubation track to at least one processing track disposed below the incubation track; and

pipetting the reagents, with the pipetting device, from the reagent carousel to the reaction vessels held by the at least one processing track.

11. The method of claim **10** further comprising moving the at least one processing track to move the reaction vessels held by the at least one processing track to at least one detection device, and taking readings, using the at least one detection device, of samples contained in the reaction vessels.

12. The method of claim **10** wherein the moving the incubation track holding the reaction vessels comprises moving the incubation track comprising a plurality of incubation track slots holding the reaction vessels, and the transferring the reaction vessels, using the reaction vessel exchanger device, from the incubation track to the at least one processing track disposed below the incubation track comprises transferring the reaction vessels, using the reaction vessel exchanger device, from the incubation track to a plurality of processing track slots within the at least one processing track which are disposed directly below the plurality of incubation track slots in vertical alignment.

13. The method of claim **12** wherein the moving the incubation track holding the reaction vessels comprises moving the incubation track comprising the plurality of incubation track slots holding the reaction vessels while the reaction vessels are disposed in a first orientation within the plurality of incubation track slots, and wherein the transferring the reaction vessels, using the reaction vessel exchanger device, from the incubation track to the plurality of processing track slots within the at least one processing track which are disposed directly below the plurality of incubation track slots in vertical alignment comprises a rotation member rotating the reaction vessels from the first orientation within the incubation track slots to a second orientation within the incubation track slots so that the reaction vessels pass through the incubation track slots into the processing track slots.

14. The method of claim **13** wherein the rotation member rotating the reaction vessels from the first orientation within the incubation track slots to the second orientation within the incubation track slots comprises the reaction vessels passing through a slot of an open-ended shaft and an inner shaft wall of the open-ended shaft abutting against the reaction vessels to rotate the reaction vessels from the first orientation to the second orientation.

15. The method of claim **13** further comprising a reaction vessel moving device contacting and supporting the reaction vessels and moving them through the incubation track slots into the processing track slots.

16. The method of claim **15** wherein the reaction vessel moving device contacting and supporting the reaction vessels in the second orientation comprises a flexible member fitting over and against the reaction vessels.

17. The method of claim **13** further comprising dampening movement of the reaction vessels as they move into the processing track slots with a dampening device disposed below the processing track slots.

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