(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 174 067 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.05.2017 Bulletin 2017/22

(51) Int Cl.:
G21F 5/14 *(2006.01)* ***G21F 5/00*** *(2006.01)*

(21) Application number: **15197148.8**

(22) Date of filing: **30.11.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **AREVA Inc.**
Lynchburg, VA 24501 (US)

(72) Inventor: **WOLF, Uwe**
Silver Spring, MD 20902 (US)

(74) Representative: **Lavoix**
2, place d'Estienne d'Orves
75441 Paris Cedex 09 (FR)

(54) **CANISTER MOVEMENT ASSEMBLY FOR TRANSFER, ROTATION, AND/OR INSPECTION**

(57) A movement system for moving a dry shielded canister includes a stabilization portion, and a canister support portion engaged with the stabilization portion and configured for translational movement between an extended position and a retracted position, the canister support portion including a roller interface for supporting and moving a canister. A method of moving a dry shielded canister includes moving a canister support portion engaged with the stabilization portion from a retracted positon to an extended position; moving the roller interface from a retracted position to an extended position to engage with the canister; and moving the canister.

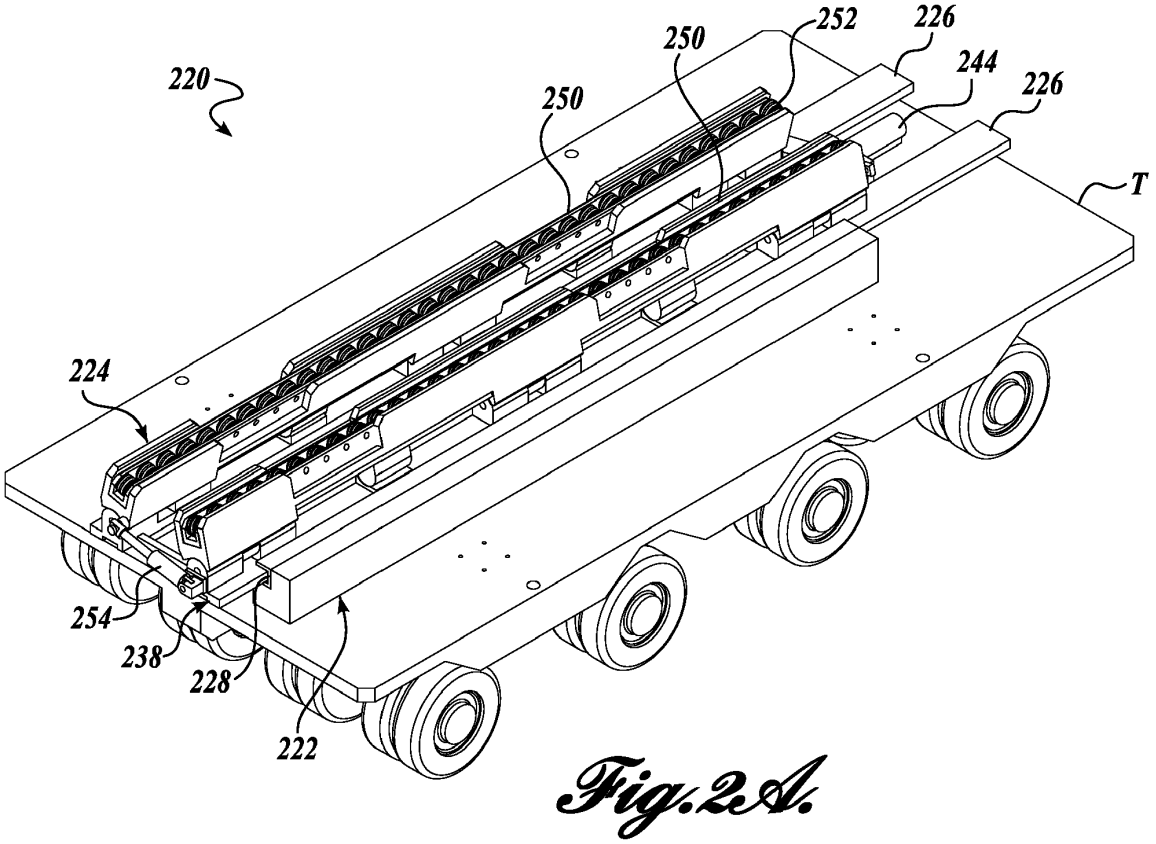


Fig.2A.

EP 3 174 067 A1

Description

BACKGROUND

[0001] Part of the operation of a nuclear power plant is the removal and disposal of irradiated nuclear fuel assemblies. Nuclear power plants often use a horizontal type of dry storage device for irradiated fuel called a dry shielded canister (DSC).

[0002] In a previously designed system, horizontal transfer of canisters containing irradiated fuel between transfer cask and horizontal storage module (HSM) is accomplished by precision alignment of metallic rails inside the transfer cask and metallic rails inside the HSM and sliding the canister on these rails. Likewise, periodic inspection and/or rotation of the canister requires further transfer of the canister from the HSM by sliding the canister on the rails.

[0003] The precision alignment method requires a crew of personnel exposed to radiation during the time of the alignment process. Sliding the metallic surface of the canister on metallic rails may leave scratches on the surface of the canister, which is a potential cause for corrosion and breaching the confinement of the canister for long term storage.

[0004] Therefore, there exists a need for improved canister transfer systems. Embodiments of the present application address these and other needs.

SUMMARY

[0005] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0006] In accordance with one embodiment of the present disclosure, a movement system for moving a dry shielded canister is provided. The system includes a stabilization portion, and a canister support portion engaged with the stabilization portion and configured for translational movement between an extended position and a retracted position, the canister support portion including a roller interface for supporting and moving a canister.

[0007] In accordance with another embodiment of the present disclosure, a method of moving a dry shielded canister is provided. The method includes moving a canister support portion engaged with a stabilization portion from a retracted positon to an extended position; moving the roller interface from a retracted position to an extended position to engage with the canister; and moving the canister.

[0008] In any of the embodiments described herein, the canister support portion may be slidingly engaged with the stabilization portion.

[0009] In any of the embodiments described herein, the roller interface may include a plurality of roller rails.

[0010] In any of the embodiments described herein, the roller rails may include a plurality of rollers.

[0011] In any of the embodiments described herein, the roller rails may be configurable for orientation in extended and retracted positions.

[0012] In any of the embodiments described herein, the roller rails may be configurable for orientation in a stowed position.

[0013] In any of the embodiments described herein, the roller rails may be configurable for translational or rotational movement or both.

[0014] In any of the embodiments described herein, the system may further include a support vehicle to which the stabilization portion is coupled.

[0015] In any of the embodiments described herein, the system may further include canister inspection means adapted to inspect the canister as it moves on the roller rails.

[0016] In any of the embodiments described herein, the system may further include a canister inspection system.

[0017] In any of the embodiments described herein, a method of moving a canister may further include moving the canister translationally or rotationally or both.

[0018] In any of the embodiments described herein, the canister may be moved rotationally while in a horizontal storage module.

[0019] In any of the embodiments described herein, a method of moving a canister may further include retracting the roller interface after moving the canister.

[0020] In any of the embodiments described herein, a method of moving a canister may further include retracting the canister support portion after retracting the roller interface.

[0021] In any of the embodiments described herein, a method of moving a canister may further include inspecting the canister while moving the canister.

DESCRIPTION OF THE DRAWINGS

[0022] The foregoing aspects and many of the attendant advantages of this disclosure will become more readily appreciated by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is an isometric view of a movement system for a canister in accordance with one embodiment of the present disclosure;

FIGURES 2A and 2B are isometric views of the movement system of FIGURE 1 in respective retracted and extended position:

FIGURES 3A through 3D are cross-section views of roller rails in respective stowed, retracted, extended, and rotational orientations;

FIGURES 4A through 9 are various isometric views showing methods of using the movement system in accordance with embodiments of the present disclo-

sure; and

FIGURES 10-16 are various views directed to another embodiment of a movement system for a canister in accordance with the present disclosure.

DETAILED DESCRIPTION

[0023] The detailed description set forth below in connection with the appended drawings, where like numerals reference like elements, is intended as a description of various embodiments of the disclosed subject matter and is not intended to represent the only embodiments. Each embodiment described in this disclosure is provided merely as an example or illustration and should not be construed as preferred or advantageous over other embodiments. The illustrative examples provided herein are not intended to be exhaustive or to limit the disclosure to the precise forms disclosed. Similarly, any steps described herein may be interchangeable with other steps, or combinations of steps, in order to achieve the same or substantially similar result.

[0024] In the following description, numerous specific details are set forth in order to provide a thorough understanding of exemplary embodiments of the present disclosure. It will be apparent to one skilled in the art, however, that many embodiments of the present disclosure may be practiced without some or all of the specific details. In some instances, well-known process steps have not been described in detail in order not to unnecessarily obscure various aspects of the present disclosure. Further, it will be appreciated that embodiments of the present disclosure may employ any combination of the features described herein.

[0025] Embodiments of the present disclosure are directed to canister movement assemblies used for canister C transfer between a cask K and an HSM 10, as well as for periodic rotation and inspection of the canister C within an HSM 10.

[0026] Referring now to FIGURES 1-3D, a canister movement assembly 220 in accordance with one embodiment of the present disclosure will now be described. The canister movement assembly 220 may be used in conjunction with a staggered HSM 10 as described in the present application or in other types of HSMs or other storage modules, including but not limited to indoor storage, centralized interim storage (CIS), and stacked CIS storage. The canister movement assembly 220 may be used for transferring a dry shielded canister (DSC) or for different types of canisters.

[0027] Referring to FIGURES 1 and 2, the canister movement assembly 220 is a retractable roller mechanism for lateral transfer and axial rotation of canisters C. In the illustrated embodiment, the canister movement assembly 220 is attached to a trailer T and includes a stabilization portion 222 and a canister support portion 224 capable of extending and retracting from the stabilization portion 222. The canister movement assembly 220 includes an actuator 244 for extending and retracting the canister support portion 224 from the stabilization portion 222. The canister support portion 224 moves translationally between retracted and extended positions (compare FIGURES 2A and 2B). In the illustrated embodiment, the actuator 244 is a telescoping actuator. However, other actuator systems are within the scope of the present disclosure.

[0028] Referring to FIGURES 1, 2A, and 2B, the canister movement assembly 220 is positioned on the trailer T under the skid S and the cask K. In this configuration, the canister movement assembly 220 is not in contact with the skid S or the cask K, but is deployable for use with the canister C, whether the canister C is contained within the cask K or within an adjacent compartment 30 in an HSM 10. In other embodiments, the canister movement assembly 220 may be attached to another transfer vehicle other than a trailer T.

[0029] The canister stabilization portion 222 includes two receiving rails 226 having elongate receiving channels 228 in an opposed configuration. The receiving rails are configured to slidably receive the canister support portion 224 as it moves translationally between retracted and extended positions (compare FIGURES 2A and 2B).

[0030] The receiving rails 226 of the canister stabilization portion 222 are suitable spaced from one another and suitably constructed to provide lateral and vertical support to the canister support portion 224 when it is fully loaded with a canister C and in the fully extended position (e.g., see FIGURE 7A). In addition, the strength of the coupling between the receiving rails 226 and the trailer T may provide some lateral strength to the canister movement assembly 220 when it is in its extended position.

[0031] The canister support portion 224 is configured to extend and fit within the opening 30 of the HSM 10 and the pillow blocks 34 without making contact with the HSM 10. The canister support portion 224 includes a sliding portion 238. In the illustrated embodiment, the sliding portion include sliding plates 240 configured to interface with the canister stabilization portion 222 for sliding movement within the receiving channels 228. The sliding plates 240 are suitable spaced from one another and coupled by a plurality of coupling portions 242 (see FIGURES 3A and 4A).

[0032] In the illustrated embodiment, the canister support portion 224 includes two sliding plates 240 supported by three coupling portions 242. However, any number of coupling portions to provide adequate support to the sliding plates 240 is within the scope of the present disclosure. While coupling portions 242 reduce the overall weight of the canister support portion 224, the sliding portion 238 can be configured as a single plate.

[0033] The receiving channels 228 and/or the sliding plates 240 may be lined with a bearing material or may include another suitable bearing mechanism to support the sliding movement of the canister support portion 224 relative to the canister stabilization portion 222.

[0034] Although illustrated and described as being configured for sliding translational movement in receiving

channels 228, other configurations for translational movement of the canister support portion 224 relative to the canister stabilization portion 222 are within the scope of the present disclosure.

[0035] The canister support portion 224 includes a roller interface for transferring the canister C. In the illustrated embodiment, the canister support portion 224 includes a plurality of roller rails 250 including a plurality of rollers 252. In the illustrated embodiment, the roller rails 250 are set up in two rows and are supported by the sliding portion 238, shown as sliding plates 240. The roller rails 250 are appropriately spaced from one another to provide stable support to a canister C having a circular cross-section. However, other groupings besides two and other spacings of roller rails 250 are within the scope of the present disclosure.

[0036] The rollers 252 on the roller rails 250 are designed to reduce friction as the canister C is moved translationally to or from the cask K or the HSM 10. The rollers 252 can also be used to rotate the canister C relative to its longitudinal axis for inspection or selective repositioning. For example, during inspection, the roller rails can be used to rotate the canister 360 degrees for full inspection. Inside the HSM 10, the roller rails can also be used to rotate the canister to a new stationary position. For example, the roller rails can be used to rotate the canister 180 degrees to a new stationary position.

[0037] The roller rails 250 are coupled to an actuation system 254 for moving the rails relative to the sliding portion 238 of the canister support portion 224. The actuation system 254 may include, for example, a pneumatic, hydraulic or electric rams.

[0038] Referring to the cross-sectional views of the canister movement assembly 220 in various positions in FIGURES 3A-3D, the roller rails 250 are positionable in multiple orientations to support canister C translational and/or rotational movement. Referring to FIGURE 3A, the roller rails are oriented in a first position away from each other in a stowed position. Referring to FIGURE 3B, the roller rails 250 are oriented in a second position toward each other and retracted and are ready for positioning under a canister C. Referring to FIGURE 3C, the roller rails 250 are oriented in a third position toward each other and lifted for contact with the canister C for translational movement. Referring to FIGURE 3D, the roller rails 250 are oriented in a fourth position toward each other and lifted for contact with the canister C, but oriented for rotational movement of the canister C.

[0039] Referring to FIGURES 1 and 4A-8, methods of using the horizontal transfer system 220 in accordance with embodiments of the present disclosure will now be described. Referring to FIGURE 1, the horizontal transfer system 220 is shown in a retracted position coupled to a transfer wagon T beneath the skid S and cask K and not in contact with the skid S or cask K.

[0040] Referring now to FIGURE 4A, the horizontal transfer system 220 is shown in an extended position, with the stabilization portion 222 of the horizontal transfer system 220 coupled to a transfer wagon T beneath the skid S and cask K and not in contact with the skid S or cask K, and the canister support portion 224 extended into the HSM 10. In the HSM 10, the canister support portion 224 is not in contact with the walls of the HSM 10 or the pillow blocks 34. Referring to FIGURE 4B, a corresponding cross-sectional view shows the roller rails 250 oriented in the first positon: oriented away from each other in a stowed position when the stabilization portion 222 of the horizontal transfer system 220 is in the process of being extended. In this view, the canister C is still in the cask K.

[0041] Referring now to FIGURES 5A and 5B, the roller rails 250 are moved to the second position: oriented toward each other and retracted and are ready for positioning under a canister C.

[0042] Referring now to FIGURES 6A and 6B, the roller rails 250 are moved to the third position: oriented toward each other and lifted for contact with the canister C for translational movement of the canister C from the cask K into the HSM 10. As can be seen in FIGURE 6A, a linear actuator, shown as a telescoping ram device R, pushes the canister C out of the cask K and into the entry hole 30 of the HSM 10. In FIGURE 6B, the canister C is shown traveling along the rollers 252 of the roller rails 250.

[0043] Referring now to FIGURES 7A and 7B, with the canister C fully received on the canister support portion 224 of the horizontal transfer system 220, the roller rails 250 are retracted to their second position and the canister C is lowered to rest on the pillow blocks 34 in the HSM 10. When the roller rails 250 are in the second position, the rollers 252 do not engage with the canister C. The roller rails 250 can them be returned to their first stowed position (see FIGURE 7B), and the canister support portion 224 can be withdrawn from the HSM 10 (see FIGURE 8) and returned to its retracted position (see FIGURE 1).

[0044] Removal of the canister from the HSM can be achieved by using the reverse process steps.

[0045] Referring to FIGURE 9, rotation of a canister C can be achieved by extending the canister support portion 224 and actuating the roller rails 250 such that the rollers 252 support the canister in their fourth position: toward each other and lifted for contact with the canister C for rotational movement. The lifting may be achieved, for example, by hydraulic or electric actuators. The rotating may be achieved, for example, by hydraulic or electric motors.

[0046] In previously designed transfer systems, canisters were pushed from the cask onto rails in the HSM to transfer the canister to the HSM, resulting in scratches to the canister surface and opportunities for corrosion. Advantageous effects of the horizontal transfer system described herein include reduced friction in transferring canisters and therefore reduced scratching. Reduced scratching extends the lifespan of canisters for long term storage

[0047] Further, previous rail designs were sized for

unique canister dimensions. The horizontal transfer system described in the present disclosure provides for transferring canisters of variable diameters. Likewise, the methods and systems described herein can be standardized for multiple different storage systems and multiple different canister sizes, e.g., HSMs, indoor storage, centralized interim storage (CIS), and stacked CIS storage.

[0048] In addition to reduction scratching, the pillow block system in the HSM provides improved heat transfer and less air flow restriction in the HSM as compared to HSMs configured for rail transfer. The pillow blocks also offer a wider canister support angle improving the seismic stability of the HSM as compared to HSMs configured for rail transfer.

[0049] Moreover, the rotating roller mechanism of the present disclosure combined with a method for inspecting the surface of the canister inside the HSM eliminates the need to transfer the canister out of the HSM for inspection. In addition, periodic rotation of the canister within the HSM provides a method for controlling creep of the content of the canister for long term storage.

[0050] Now referring to FIGURES 10-16, a canister movement assembly 320 in accordance with another embodiment of the present disclosure is provided. The assembly 320 of FIGURES 10-16 is substantially similar to the embodiment of FIGURES 1-9, except for differences regarding movement. The assembly 220 of FIGURES 1-9 is primarily configured for transfer movement of the canister C to and from the HSM 10. However, the assembly 320 of FIGURES 10-16 is primarily configured for rotational movement of the canister C in the HSM 10.

[0051] Like the assembly 220 of FIGURES 1-9, the assembly 320 of FIGURES 10-14 includes a canister stabilization portion 322 and a canister support portion 324 capable of extending and retracting from the stabilization portion 322. The canister stabilization portion 322 is configured to slidably receive the canister support portion 324 as it moves translationally between retracted and extended positions (compare FIGURES 13 and 14). An actuator 344 (see FIGURE 14) moves the canister support portion 324 relative to the canister stabilization portion 322. In the illustrated embodiment, the canister stabilization portion 322 is fixed to a trailer for movability of the assembly 320 and for additional stability.

[0052] The assembly 320 further includes a retractable and extendable roller mechanism for axial rotation of a canister C (compare FIGURES 15 and 16). The rollers 352 on roller rails 350 are configured in their retracted position (see FIGURE 15) when the assembly 320 is moving into its extended position in the HSM 10 (see FIGURE 14). The rollers 352 on roller rails 350 are configured in their extended position (see FIGURE 16) to lift the canister C from the pillow blocks 34 in the HSM 10 for rotation.

[0053] The assembly 320 further includes a canister inspection system 370 coupled to the assembly 320. The inspection system 370 is movable along the longitudinal axis of the assembly 320 as indicated by the arrow in FIGURE 10. Therefore, the inspection system 370 allows for inspection of the canister along any portion of the outer cylindrical surface of the canister C as it rotates. The inspection assembly may include, but is not limited to, one or more of the following components: a brush tool; a visual inspection tool; an eddy current inspection tool; and an ultra-sonic inspection tool.

[0054] The rollers 352 are designed to rotate the canister C relative to its longitudinal axis for inspection or selective repositioning in the HSM 10. For example, during inspection, the roller rails can be used to rotate the canister 360 degrees for full inspection using the inspection system 370. The roller rails 350 can also be used to rotate the canister C to a new stationary position. For example, the roller rails 350 can be used to rotate the canister C 180 degrees to a new stationary position.

[0055] The principles, representative embodiments, and modes of operation of the present disclosure have been described in the foregoing description. However, aspects of the present disclosure which are intended to be protected are not to be construed as limited to the particular embodiments disclosed. Further, the embodiments described herein are to be regarded as illustrative rather than restrictive. It will be appreciated that variations and changes may be made by others, and equivalents employed, without departing from the spirit of the present disclosure. Accordingly, it is expressly intended that all such variations, changes, and equivalents fall within the spirit and scope of the present disclosure, as claimed.

Claims

1. A movement system for moving a dry shielded canister, the system comprising:

   a stabilization portion; and
   a canister support portion engaged with the stabilization portion and configured for translational movement between an extended position and a retracted position, the canister support portion including a roller interface for supporting and moving a canister.

2. The system of Claim 1, wherein the canister support portion is slidingly engaged with the stabilization portion.

3. The system of Claim 1 or 2, wherein the roller interface includes a plurality of roller rails, the roller rails optionally including a plurality of rollers.

4. The system of Claim 3, wherein the roller rails are configurable for orientation in extended and retracted positions.

5. The system of Claim 3 or 4, wherein the roller rails are configurable for orientation in a stowed position.

6. The system of any of Claims 3 to 5, wherein the roller rails are configurable for translational or rotational movement or both.

7. The system of any of Claims 1 to 6, further comprising a support vehicle to which the stabilization portion is coupled.

8. The system of any of Claims 1 to 7, further comprising canister inspection means adapted to inspect the canister as it moves on the roller rails.

9. The system of any Claims 1 to 8, further comprising a canister inspection system.

10. A method of moving a dry shielded canister, the method comprising:

moving a canister support portion engaged with a stabilization portion from a retracted positon to an extended position;
moving the roller interface from a retracted position to an extended position to engage with the canister; and
moving the canister.

11. The method of Claim 10, further comprising moving the canister translationally or rotationally or both.

12. The method of Claim 10 or 11, wherein the canister is moved rotationally while in a horizontal storage module.

13. The method of any of Claims 10 to 12, further comprising retracting the roller interface after moving the canister.

14. The method of any of Claims 10 to 13, further comprising retracting the canister support portion after retracting the roller interface.

15. The method of any of Claims 10 to 14, further comprising inspecting the canister while moving the canister.

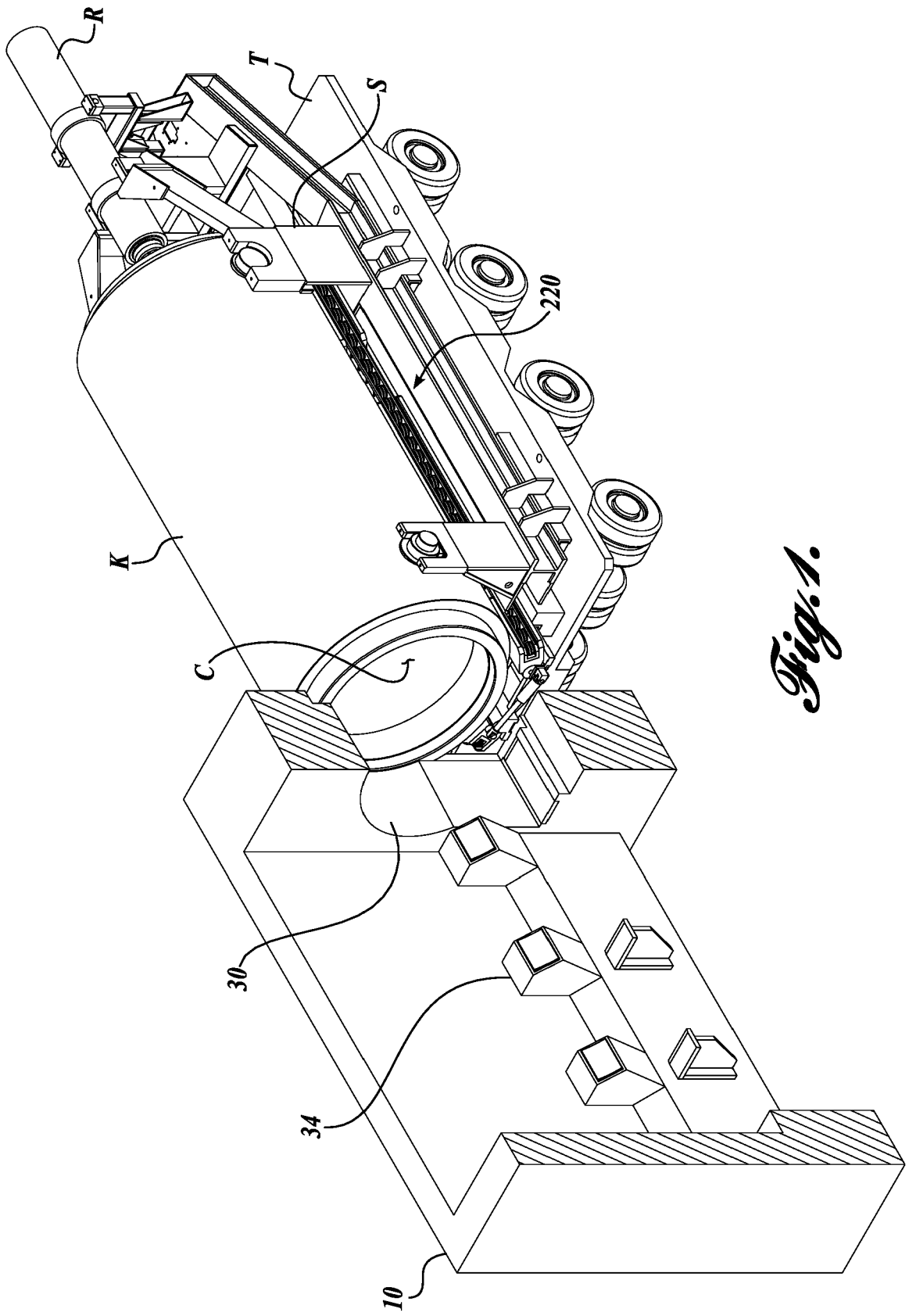


Fig. 1.

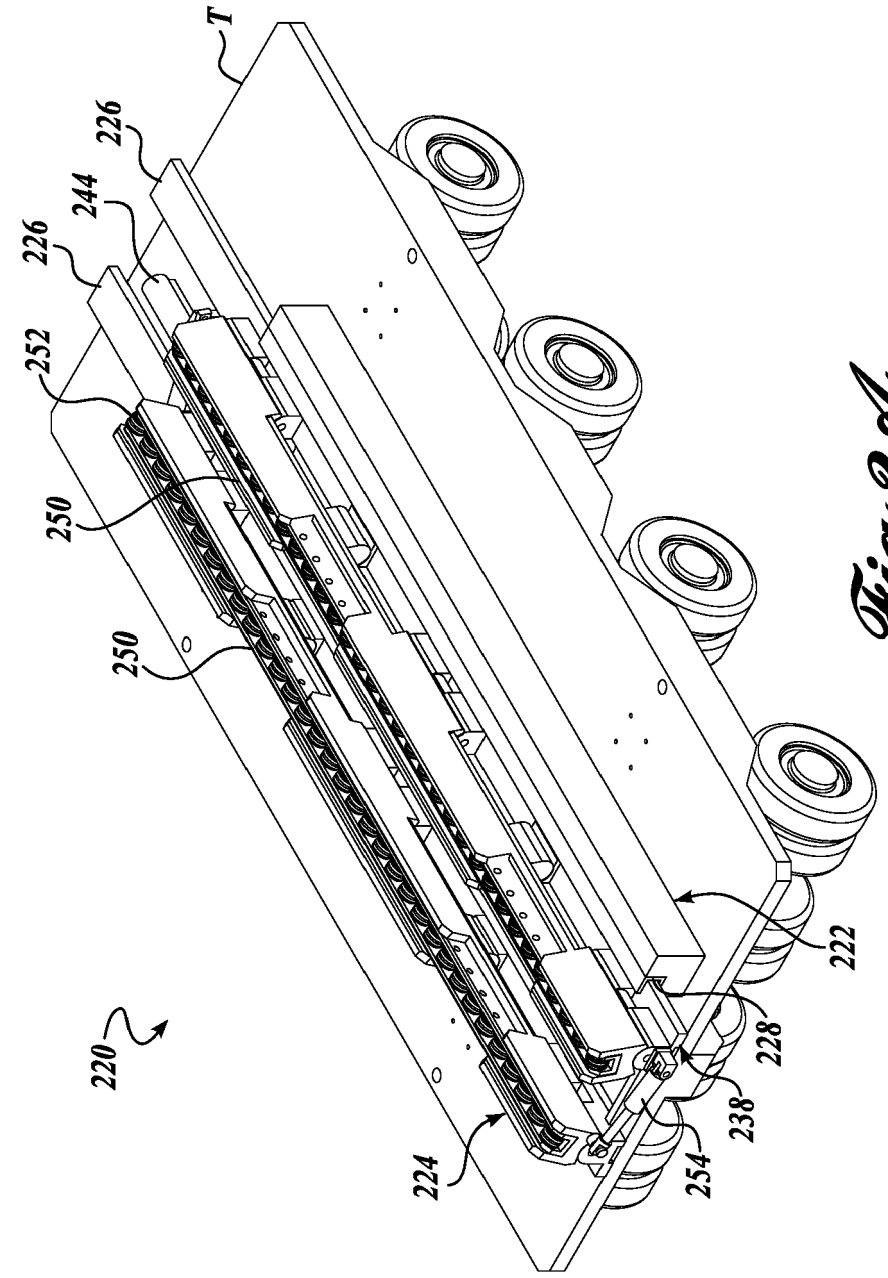


Fig. 2A.

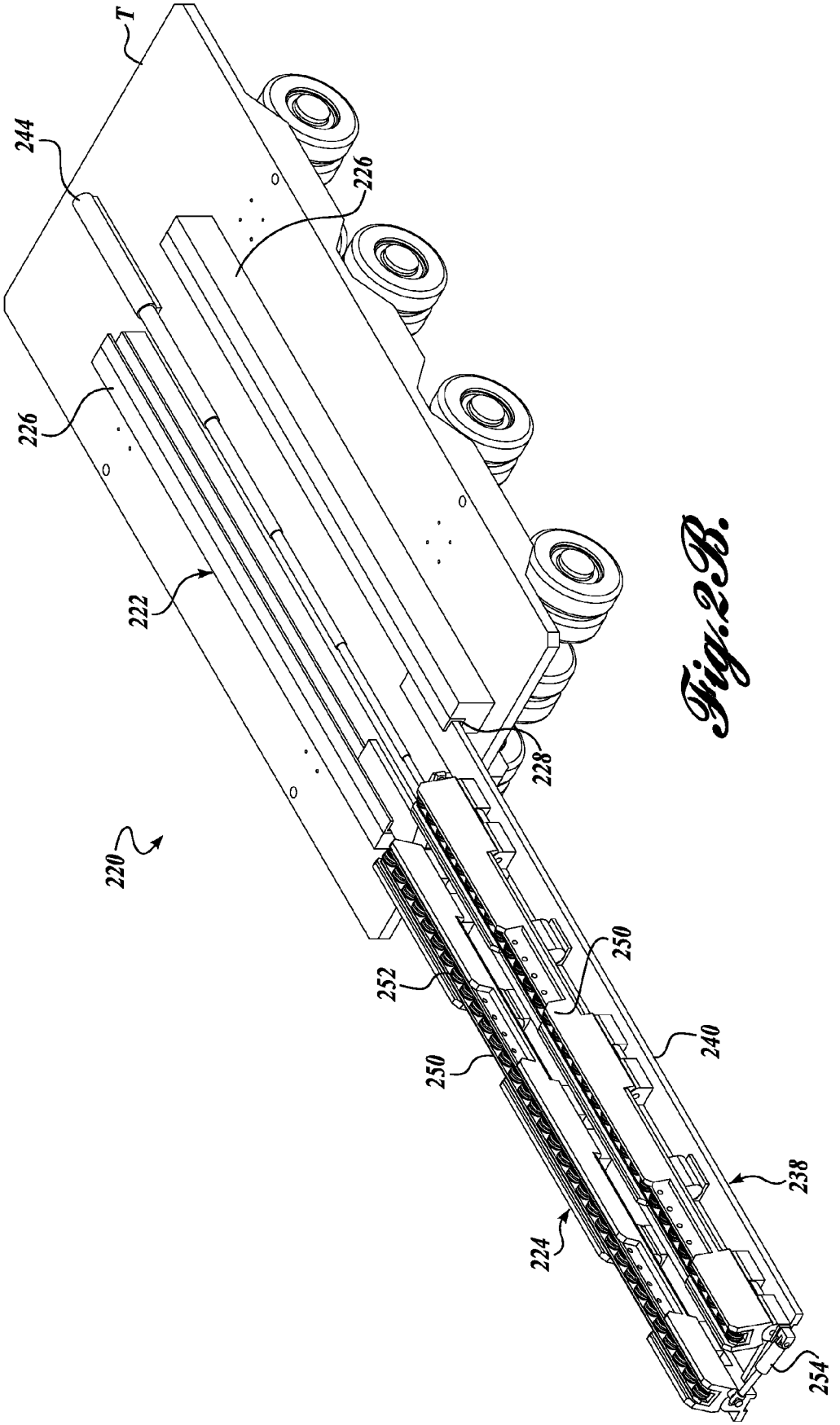


Fig. 2B.

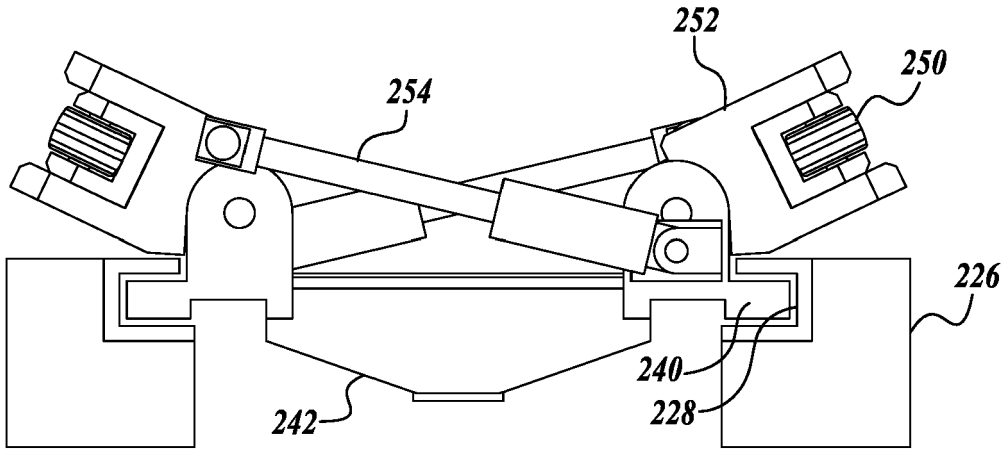


Fig.3A.

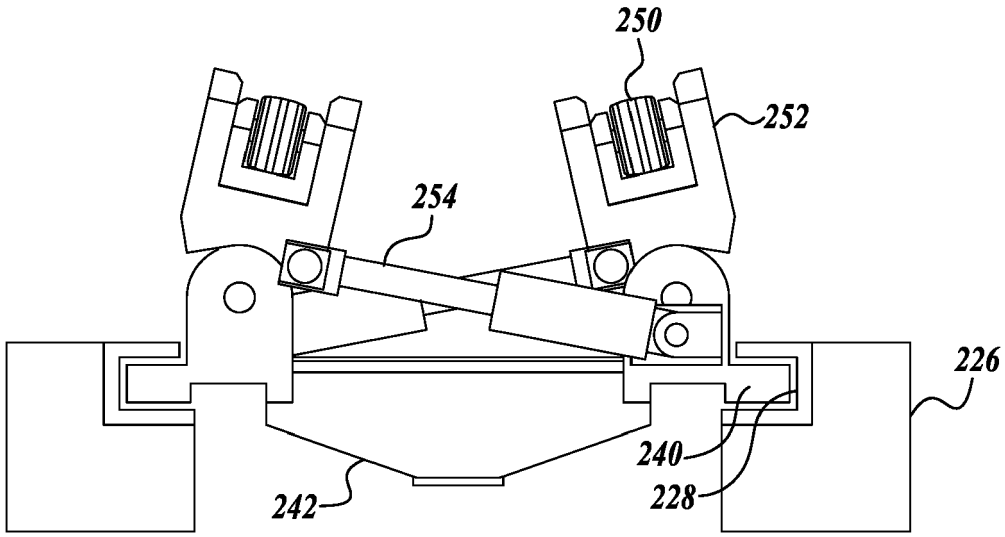


Fig.3B.

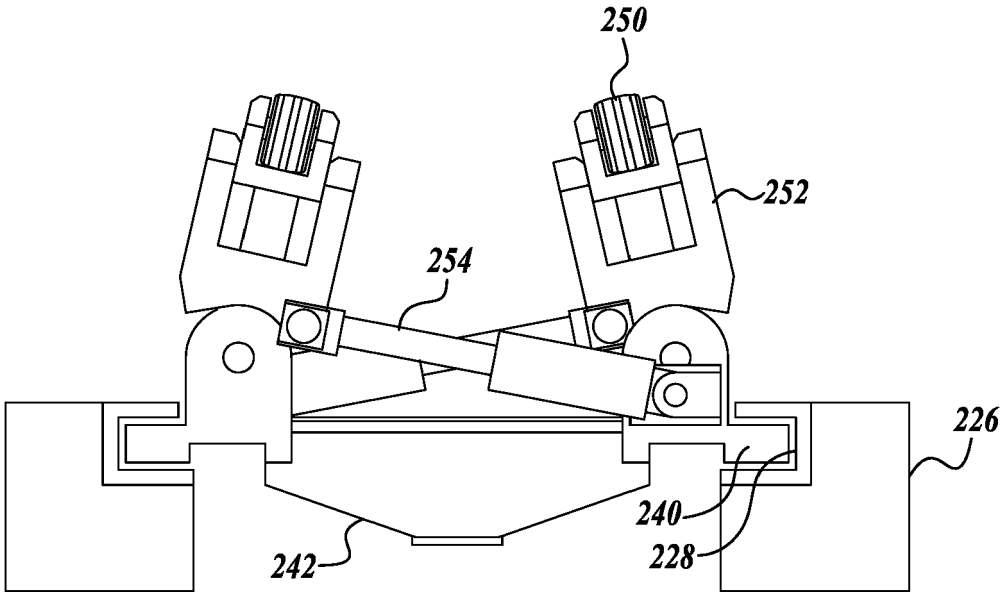


Fig.3C.

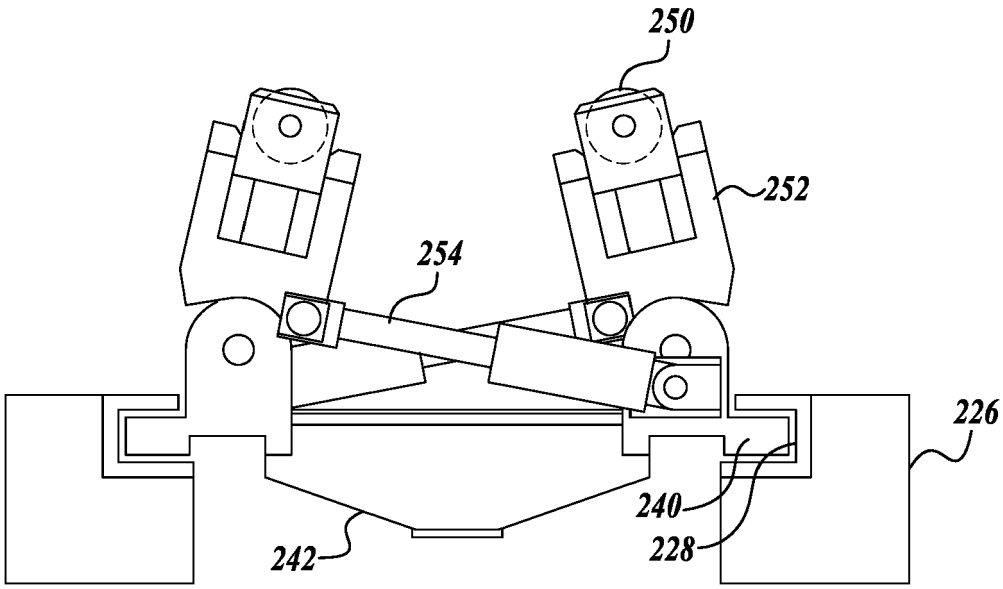


Fig.3D.

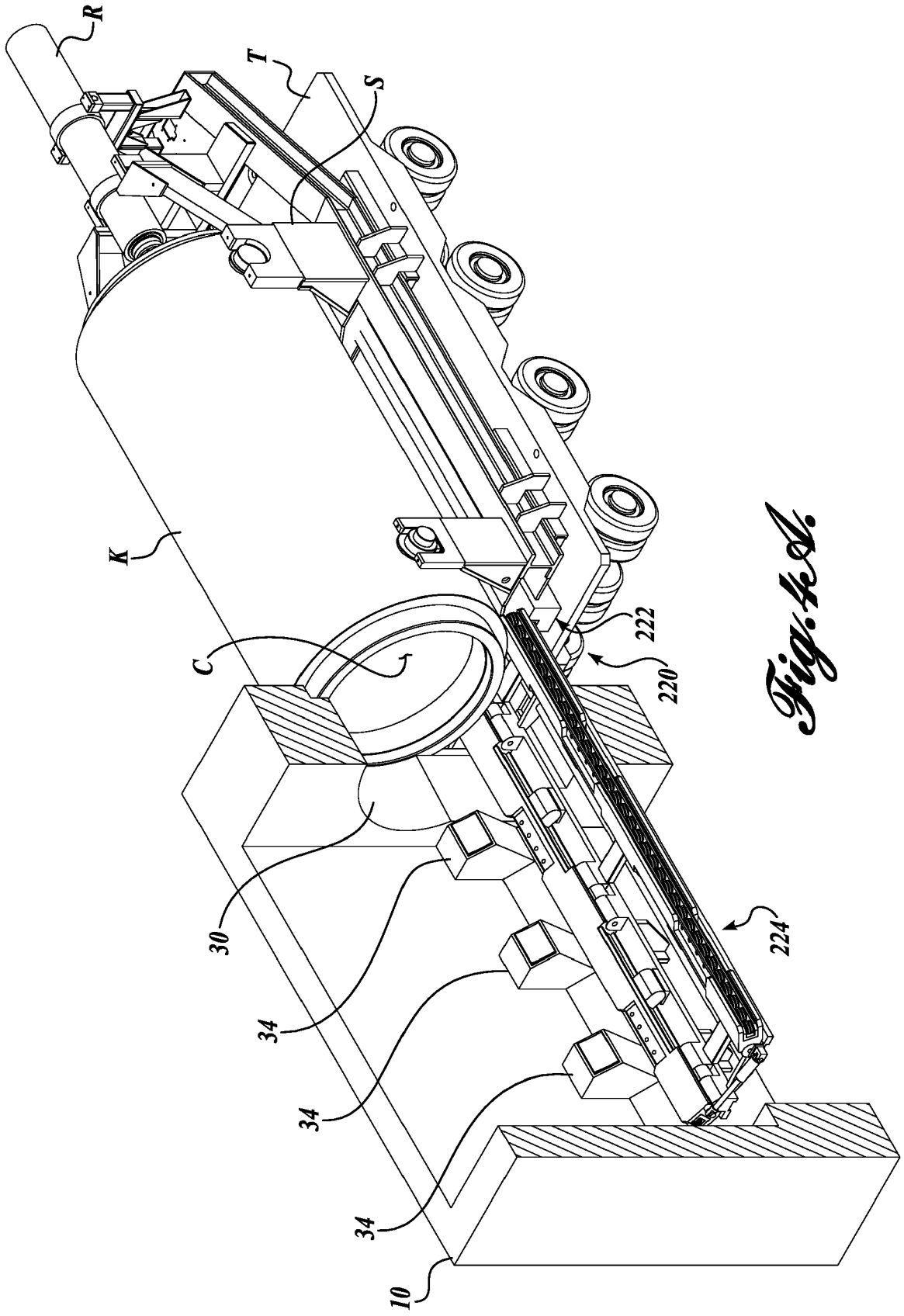


Fig. 4d.

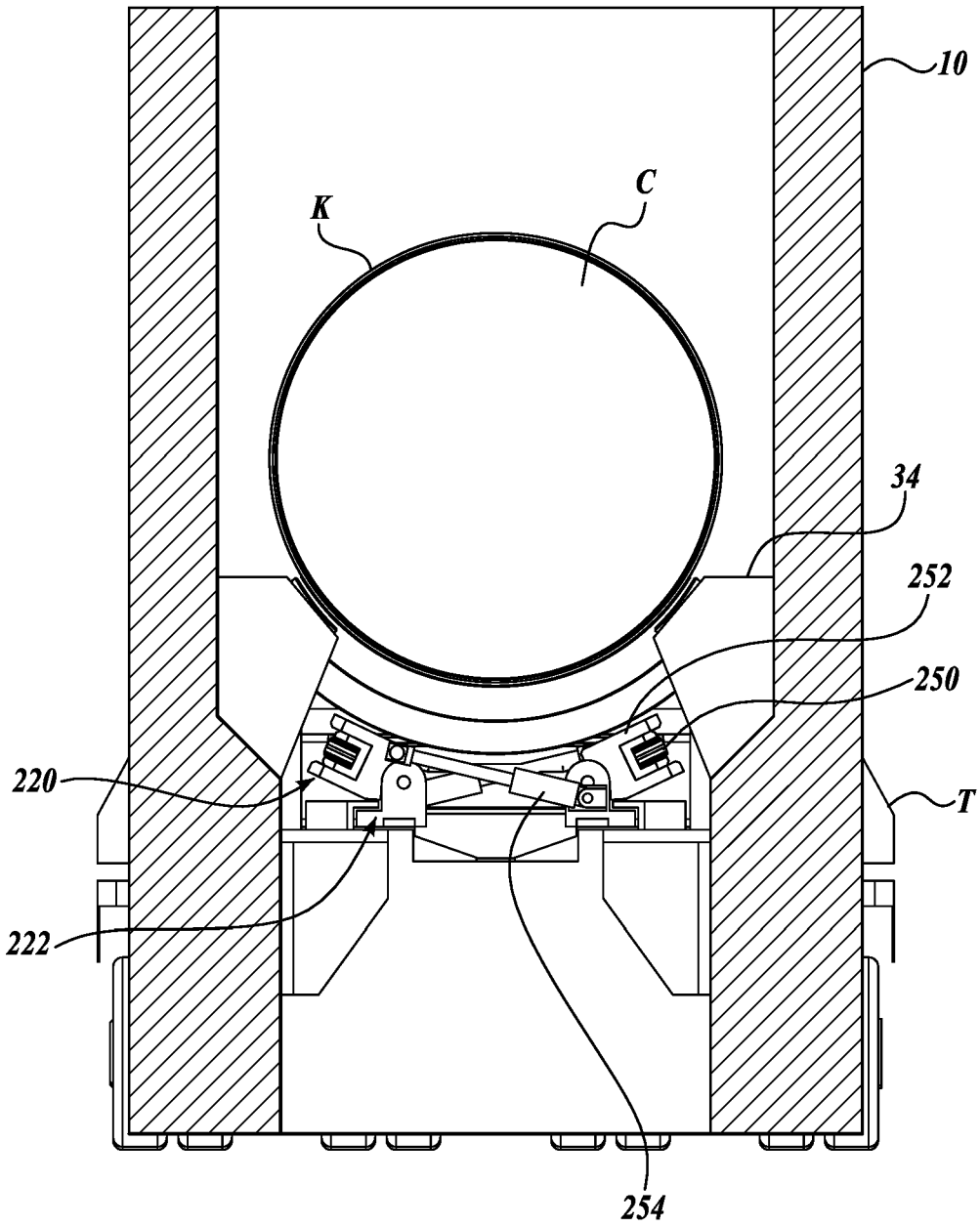


Fig.4B.

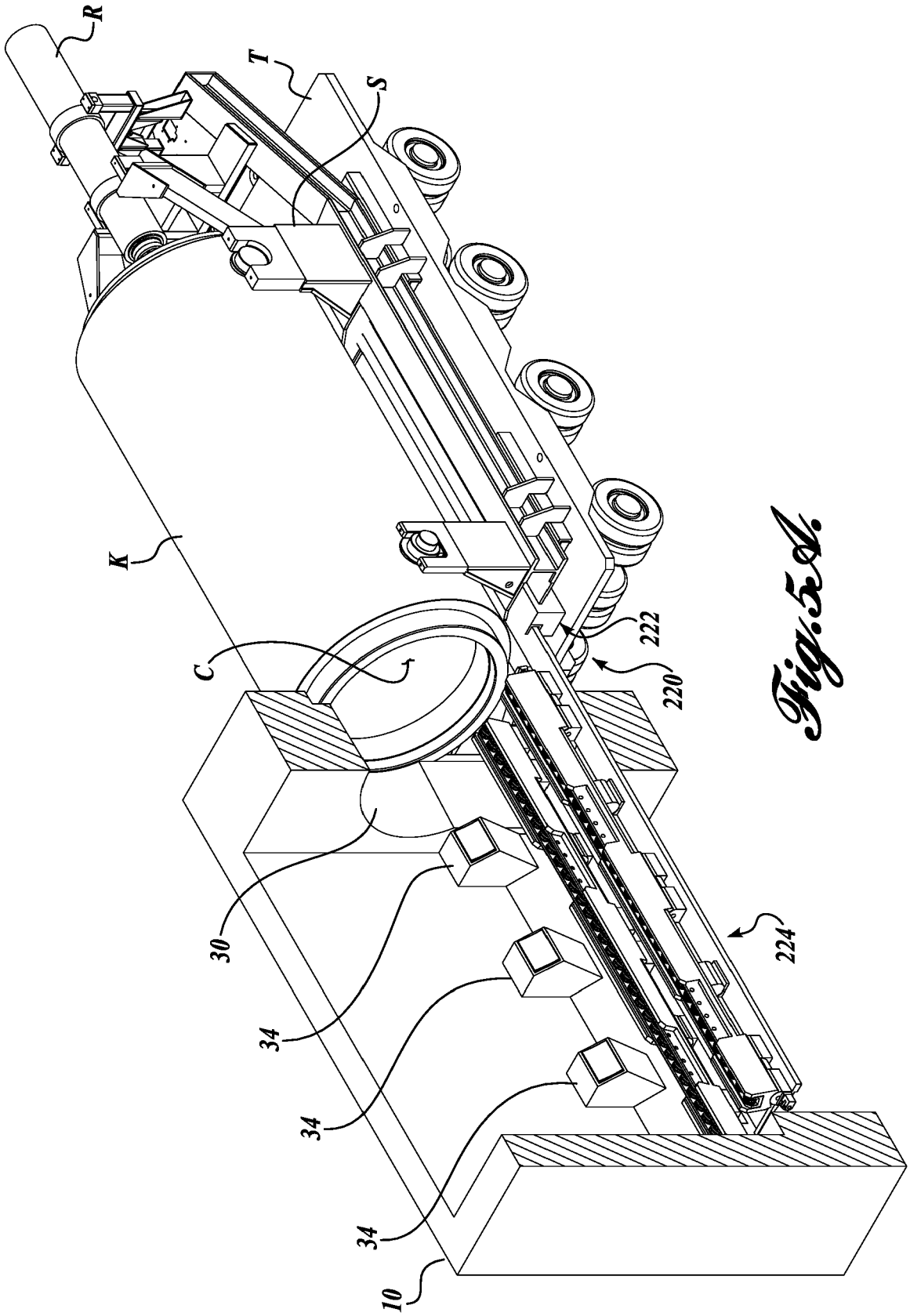


Fig. 5A

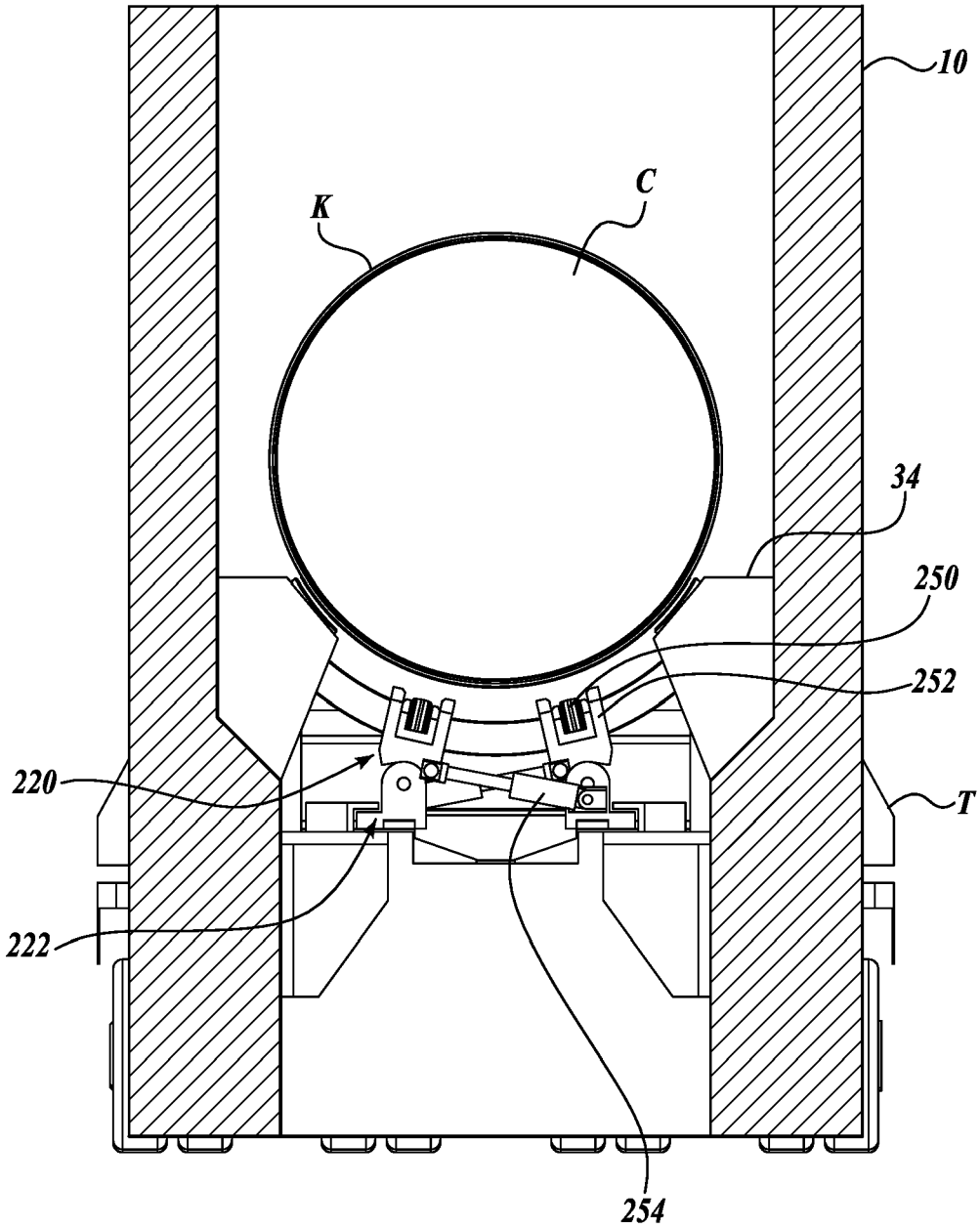


Fig.5B.

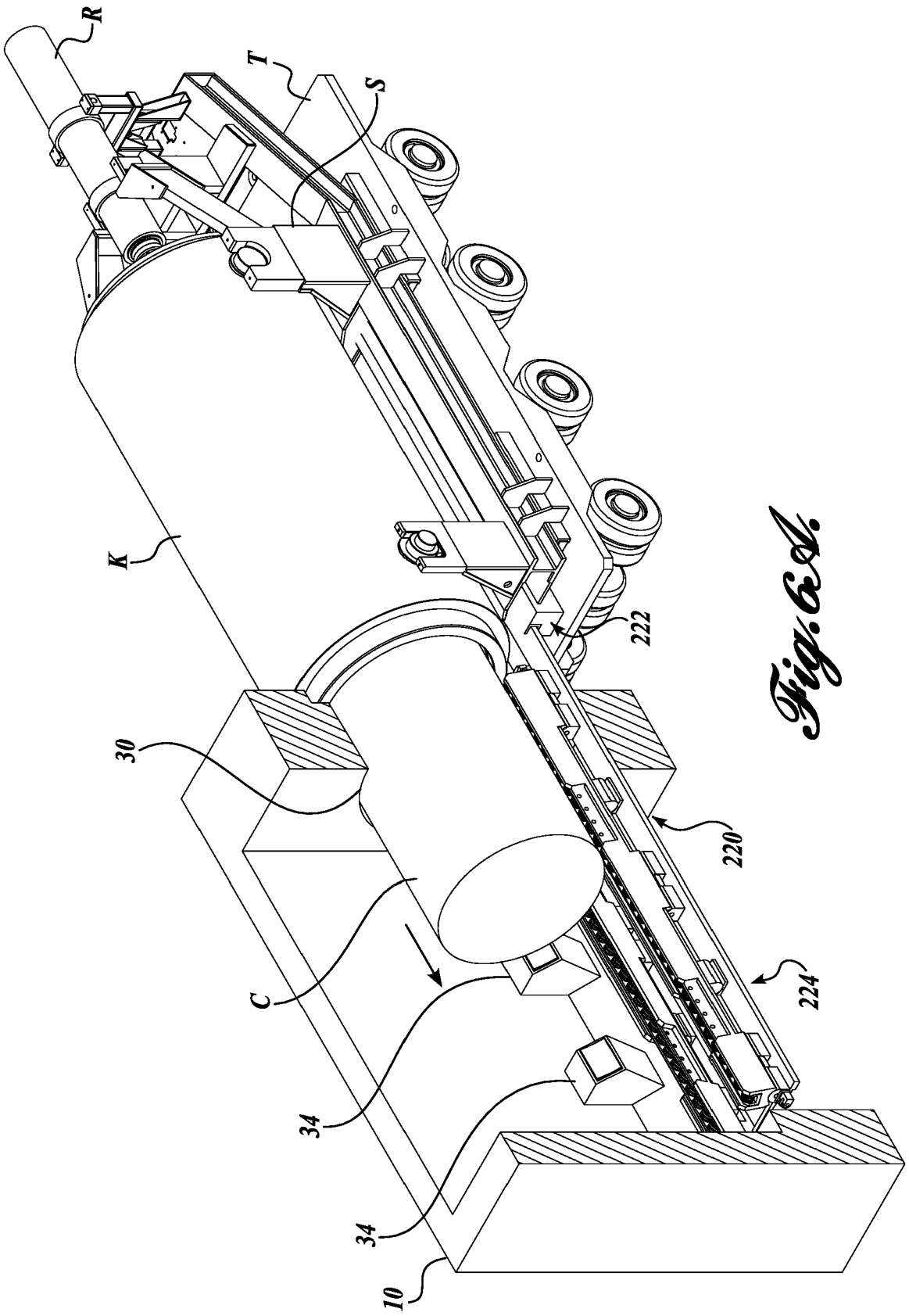


Fig. 6d.

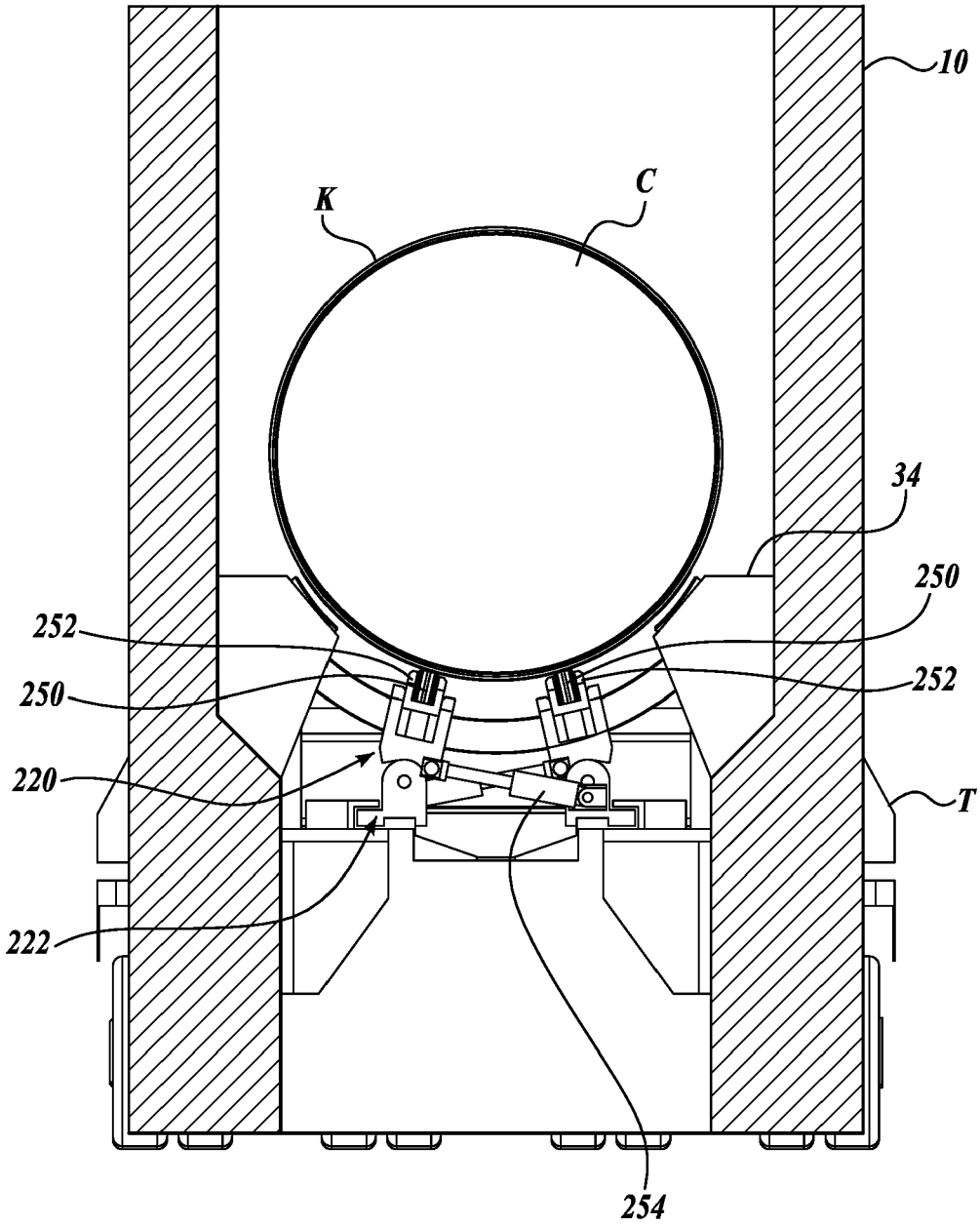


Fig.6B.

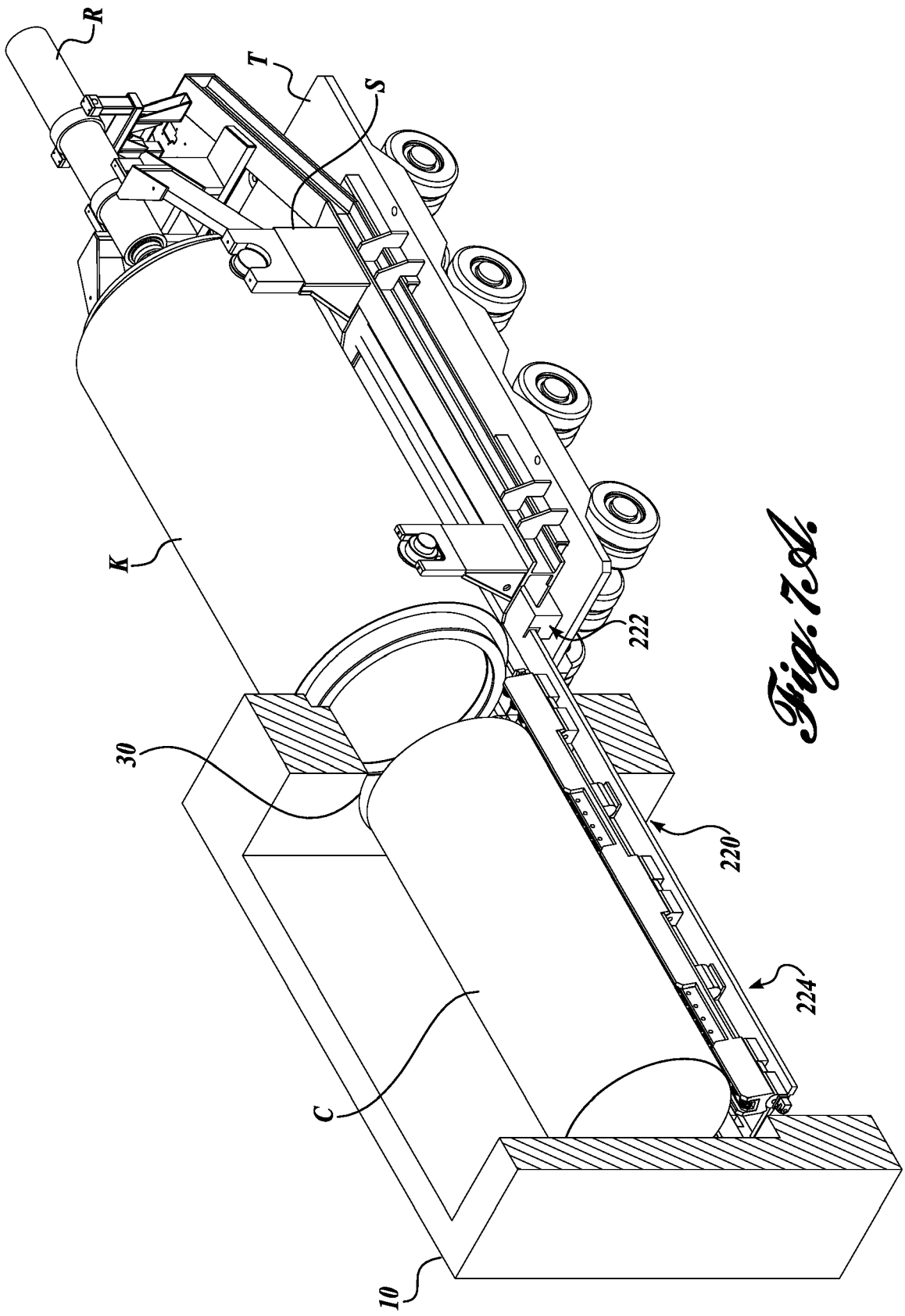


Fig. 7d.

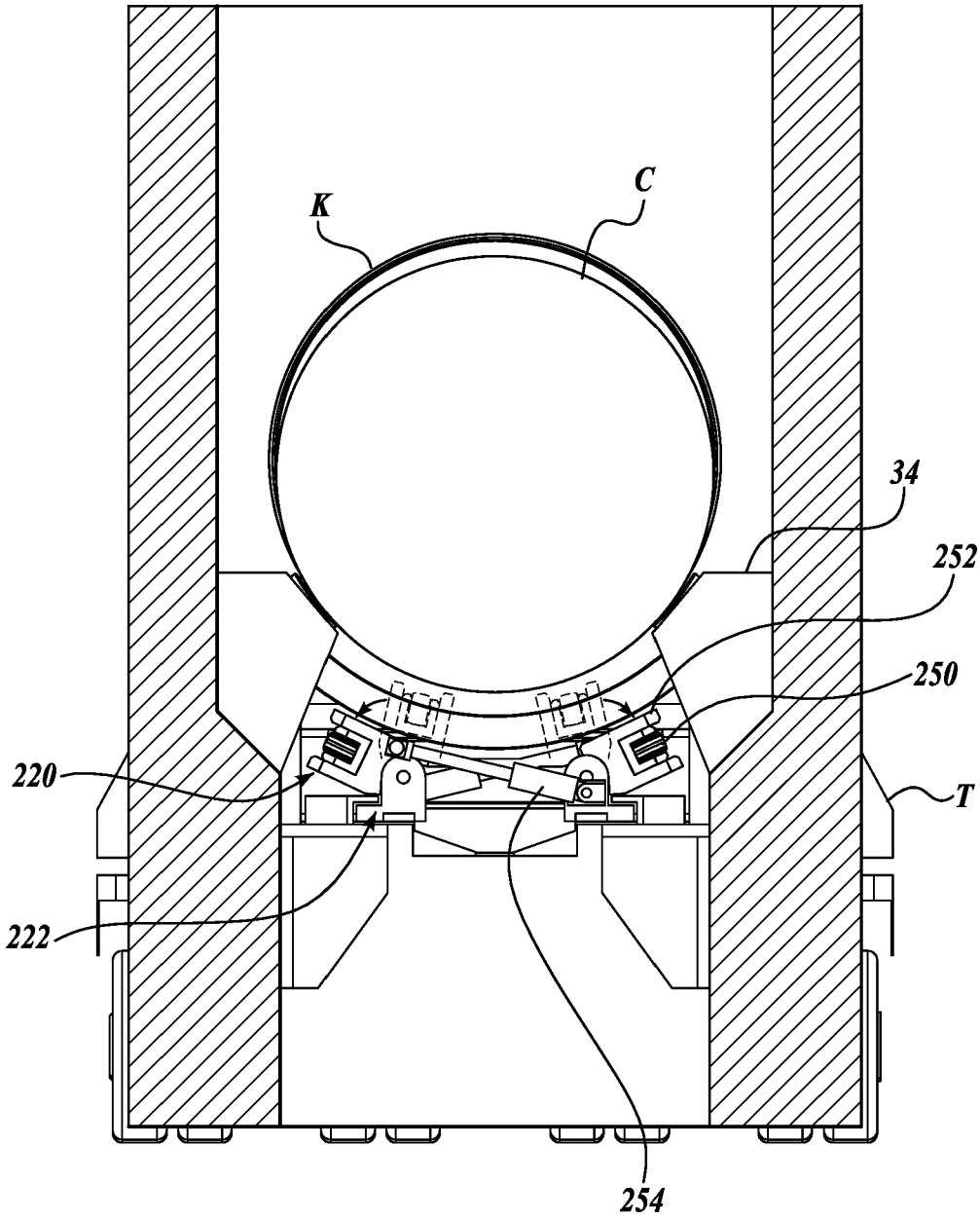


Fig. 7B.

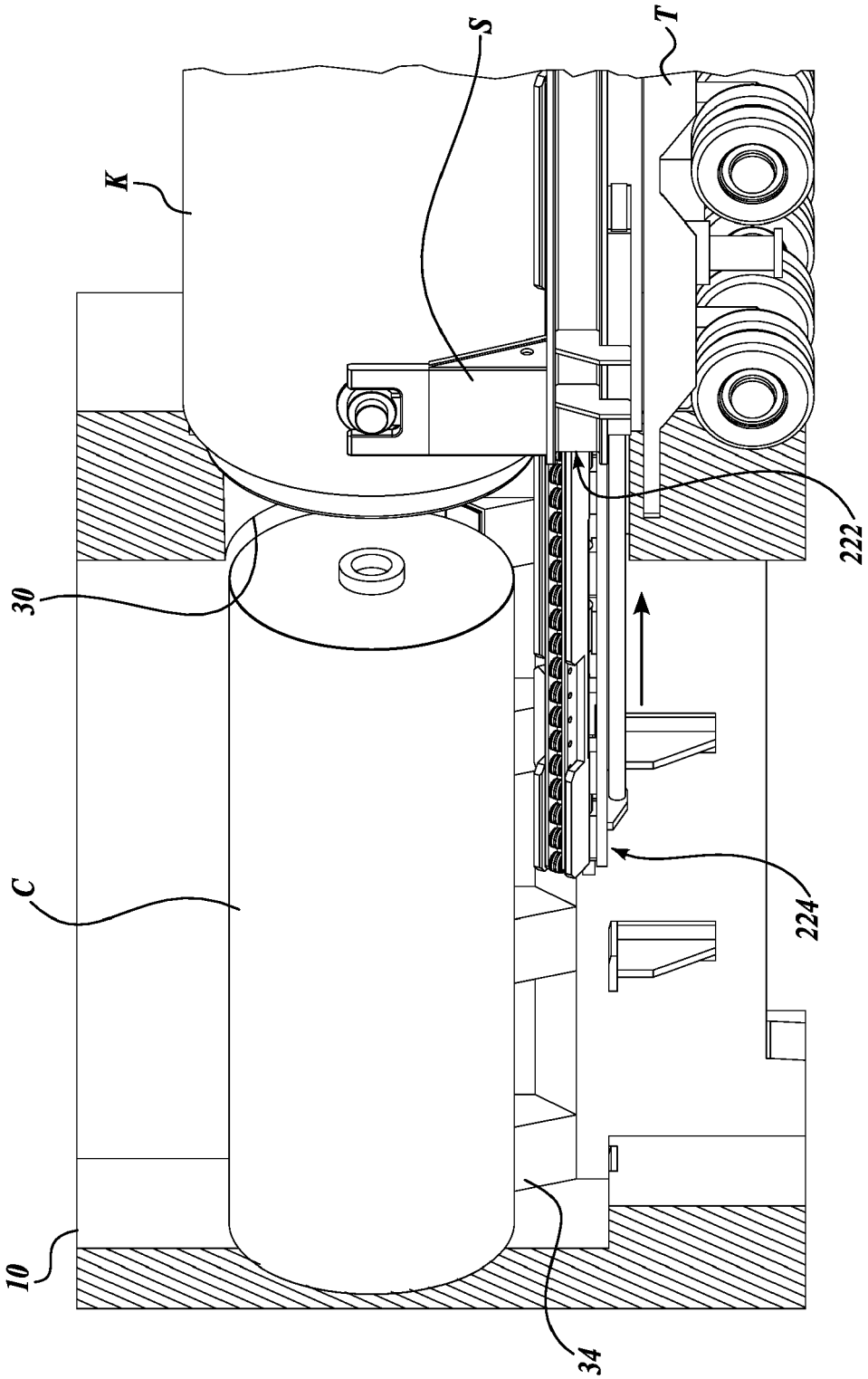


Fig. 8.

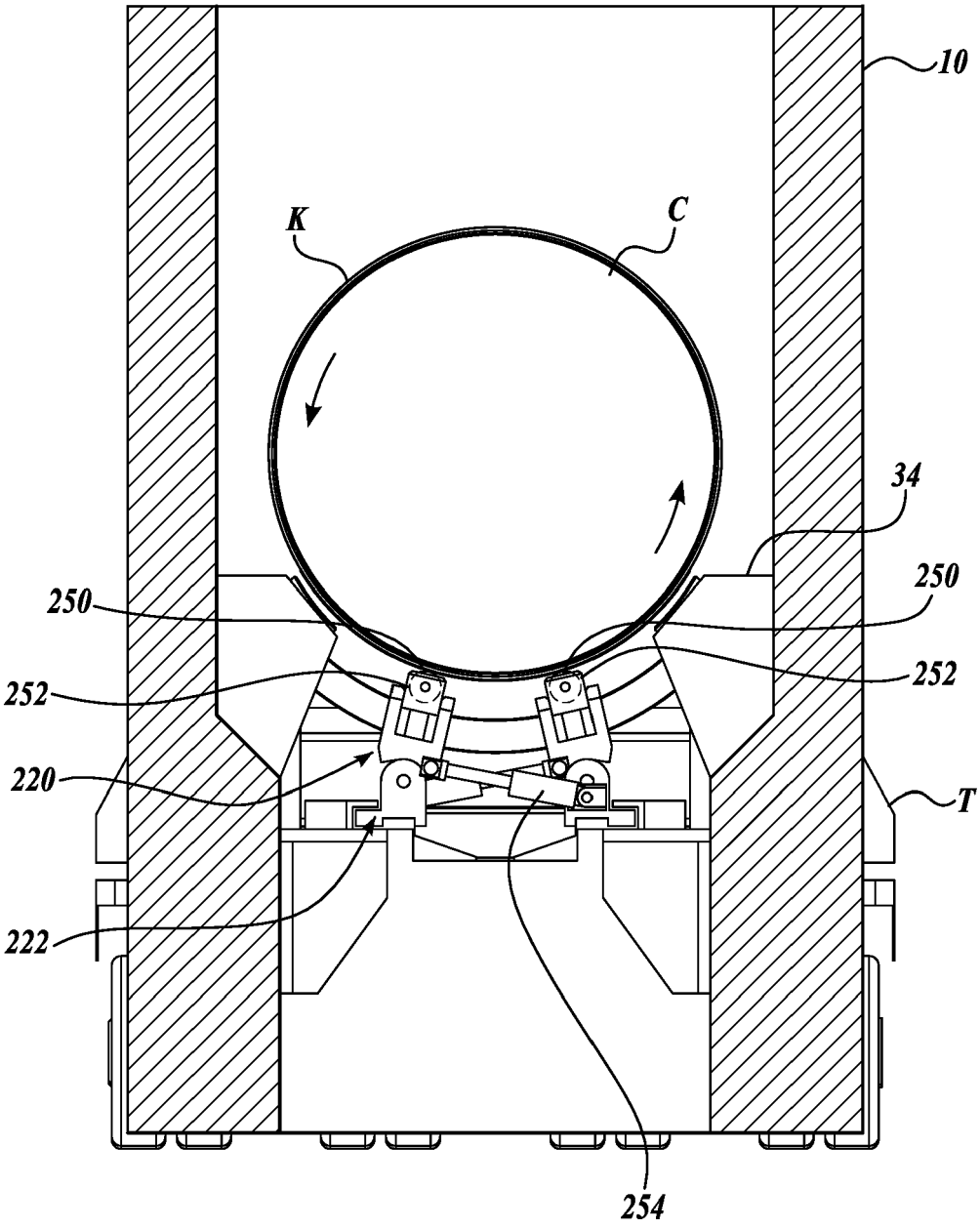


Fig.9.

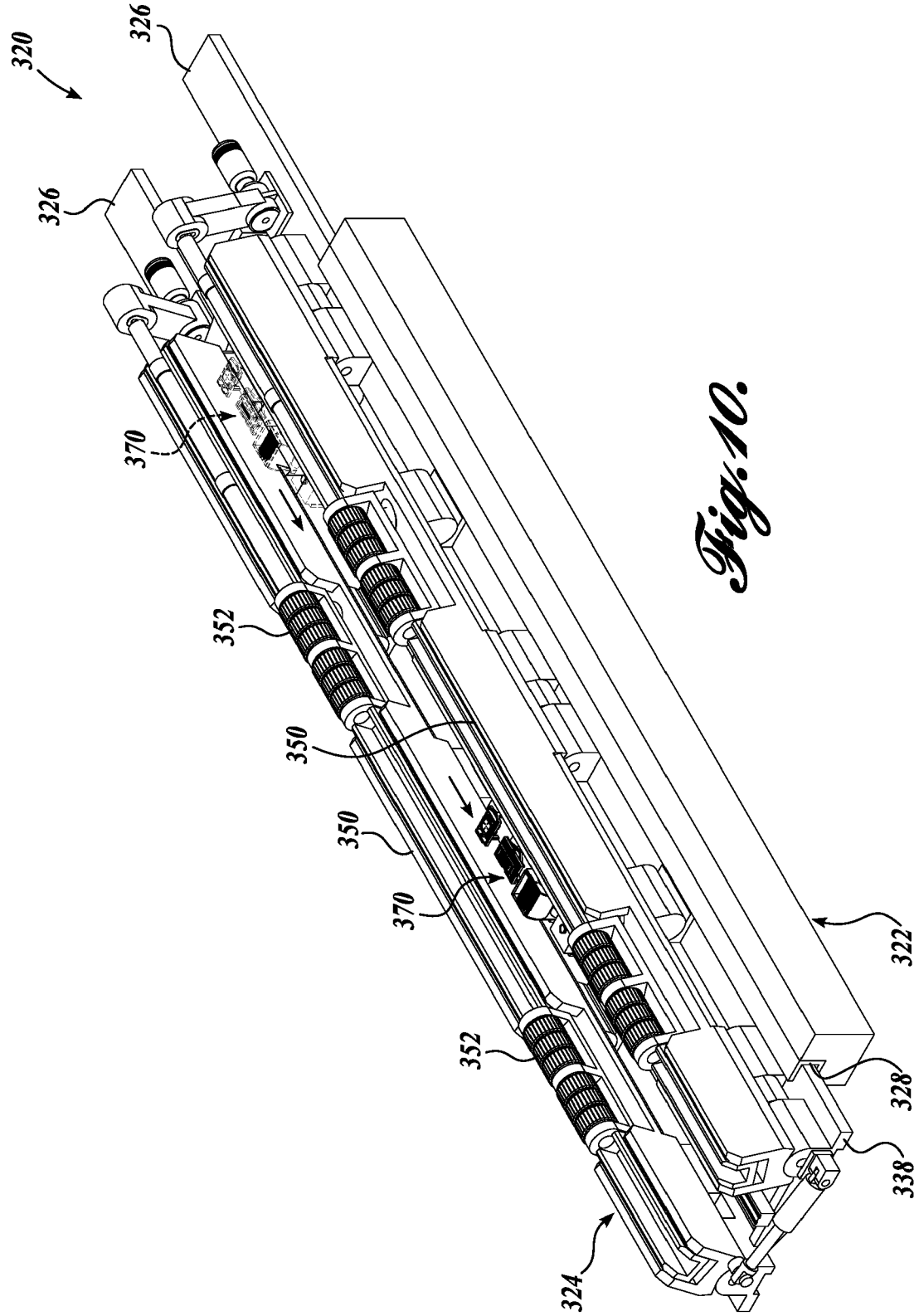


Fig. 10.

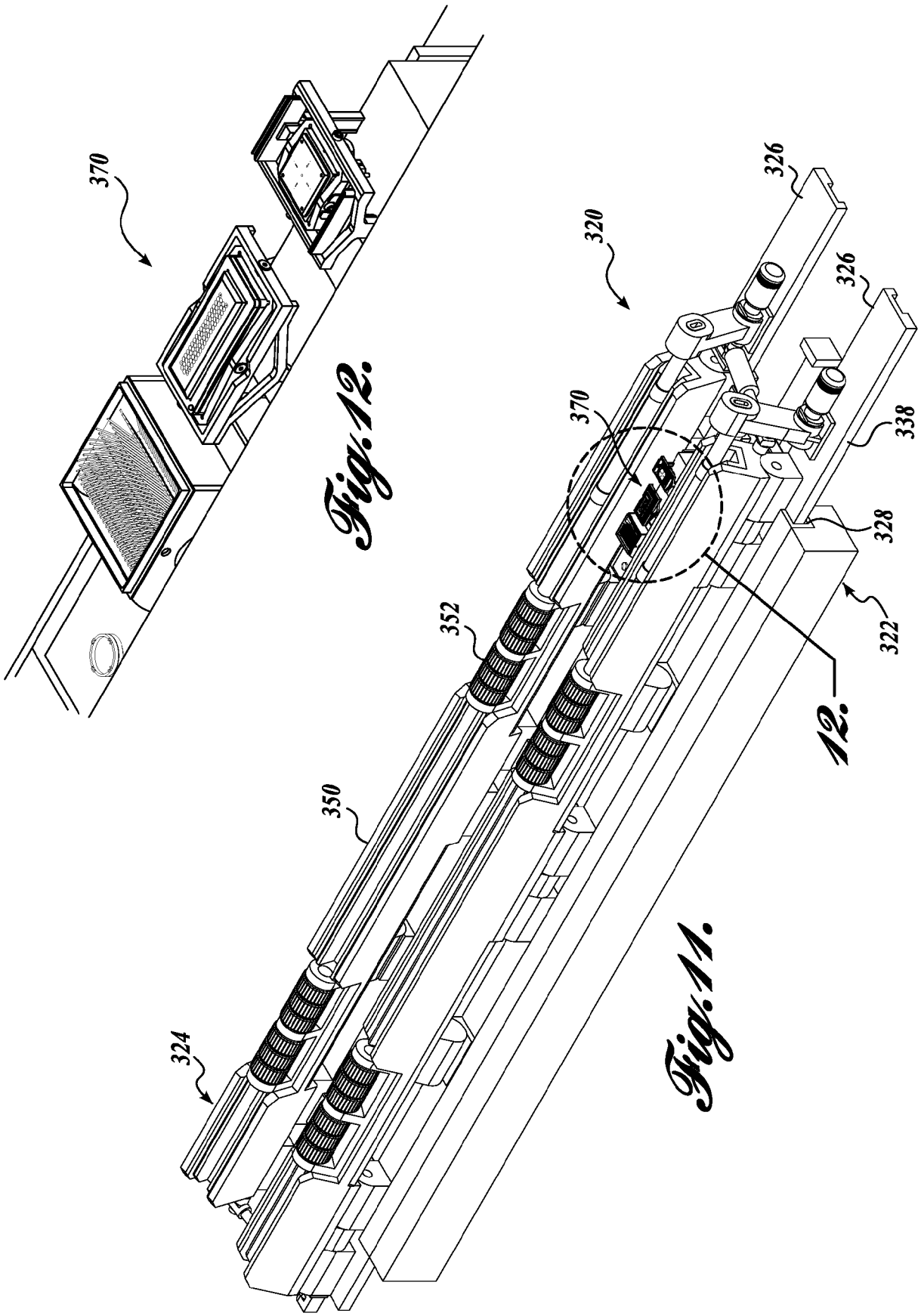


Fig. 12.

Fig. 11.

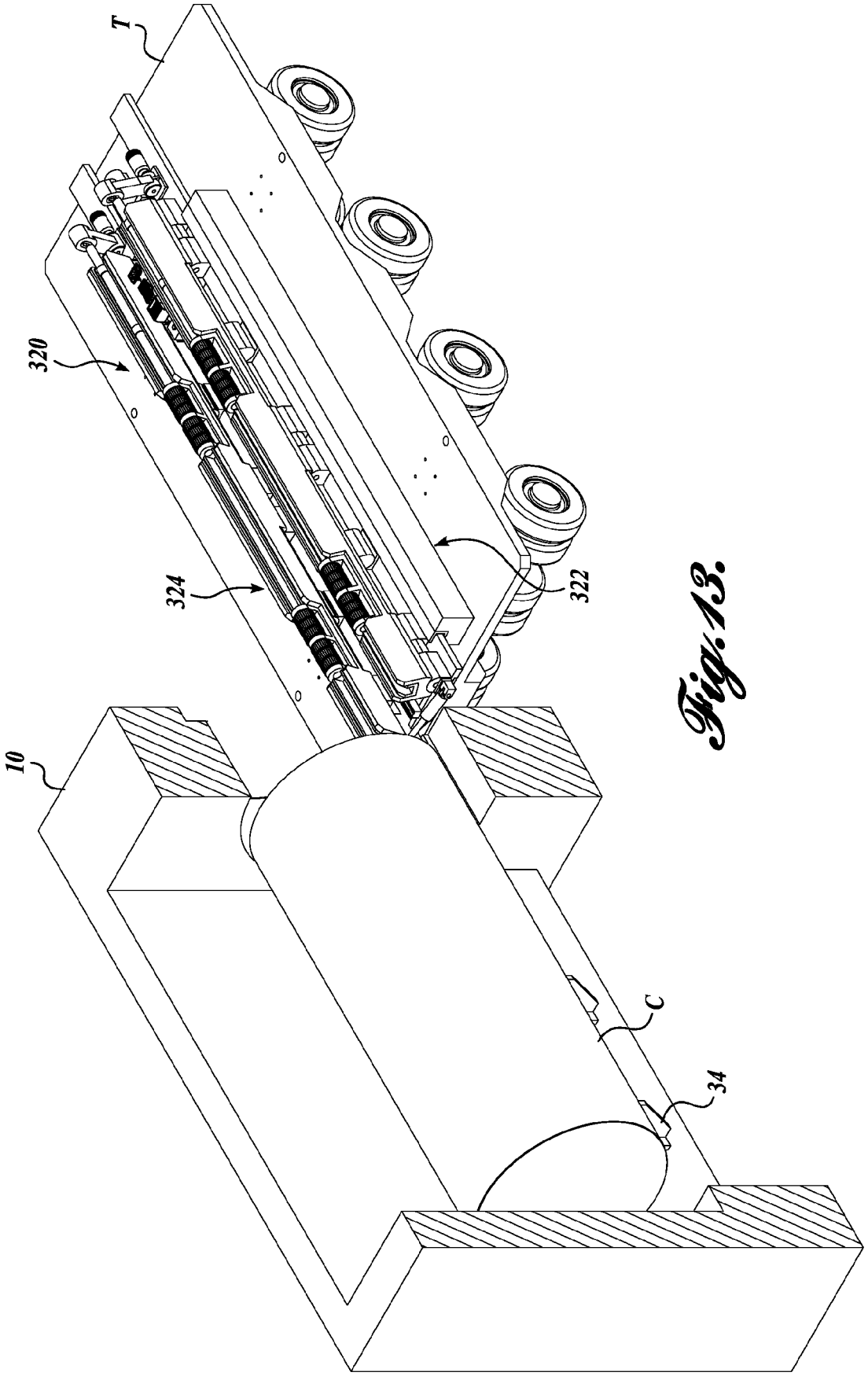


Fig. 13.

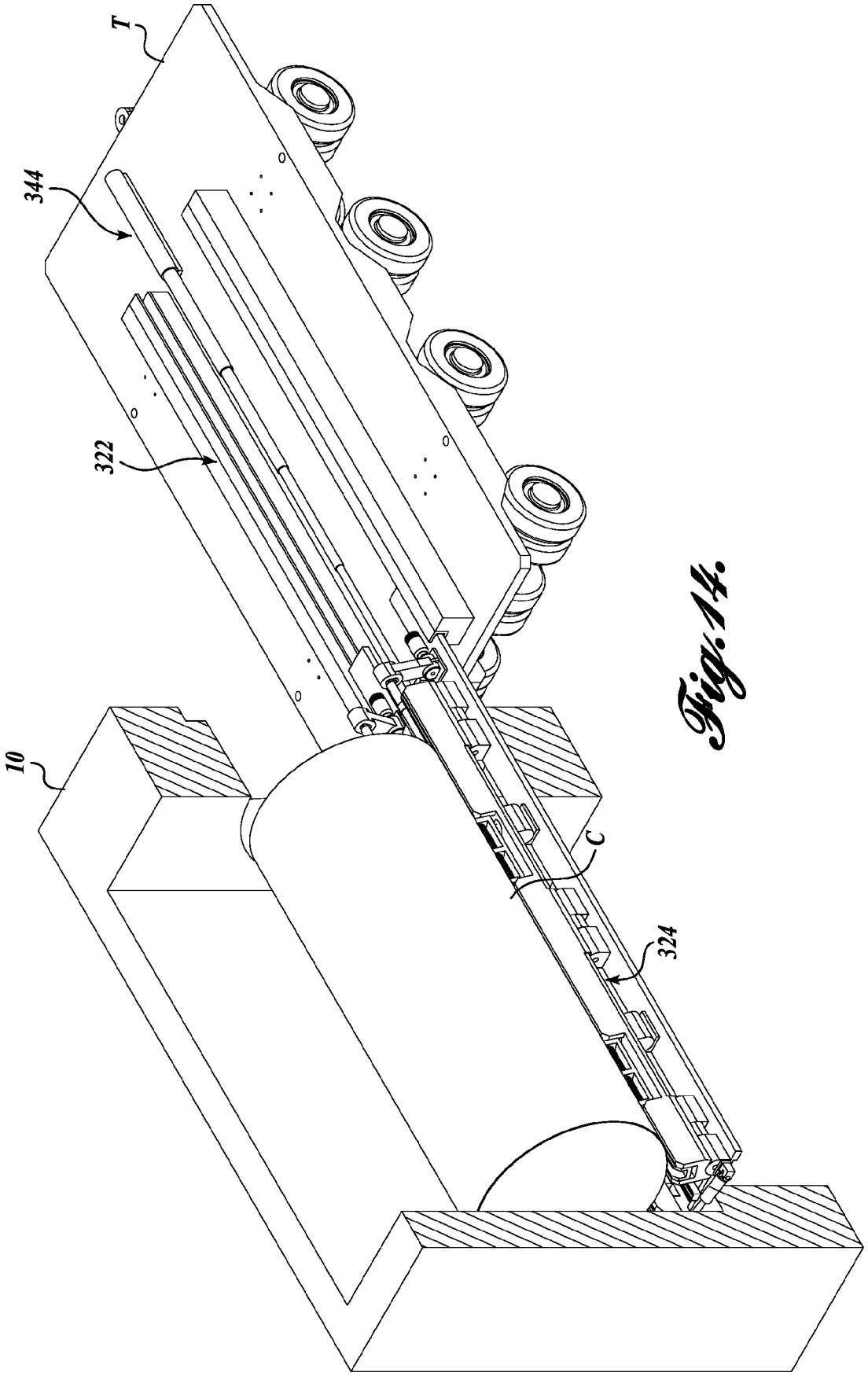


Fig. 14.

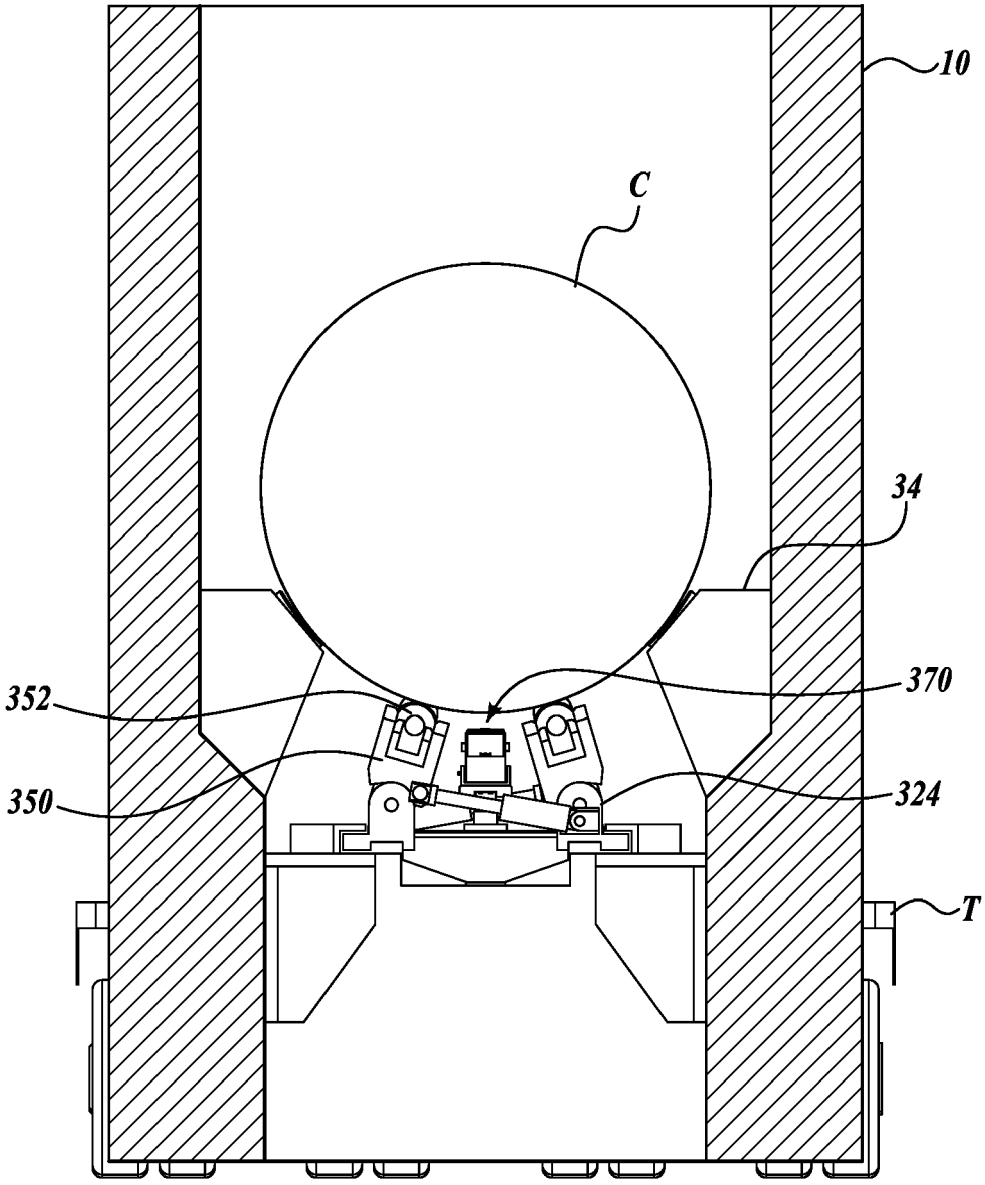


Fig. 15.

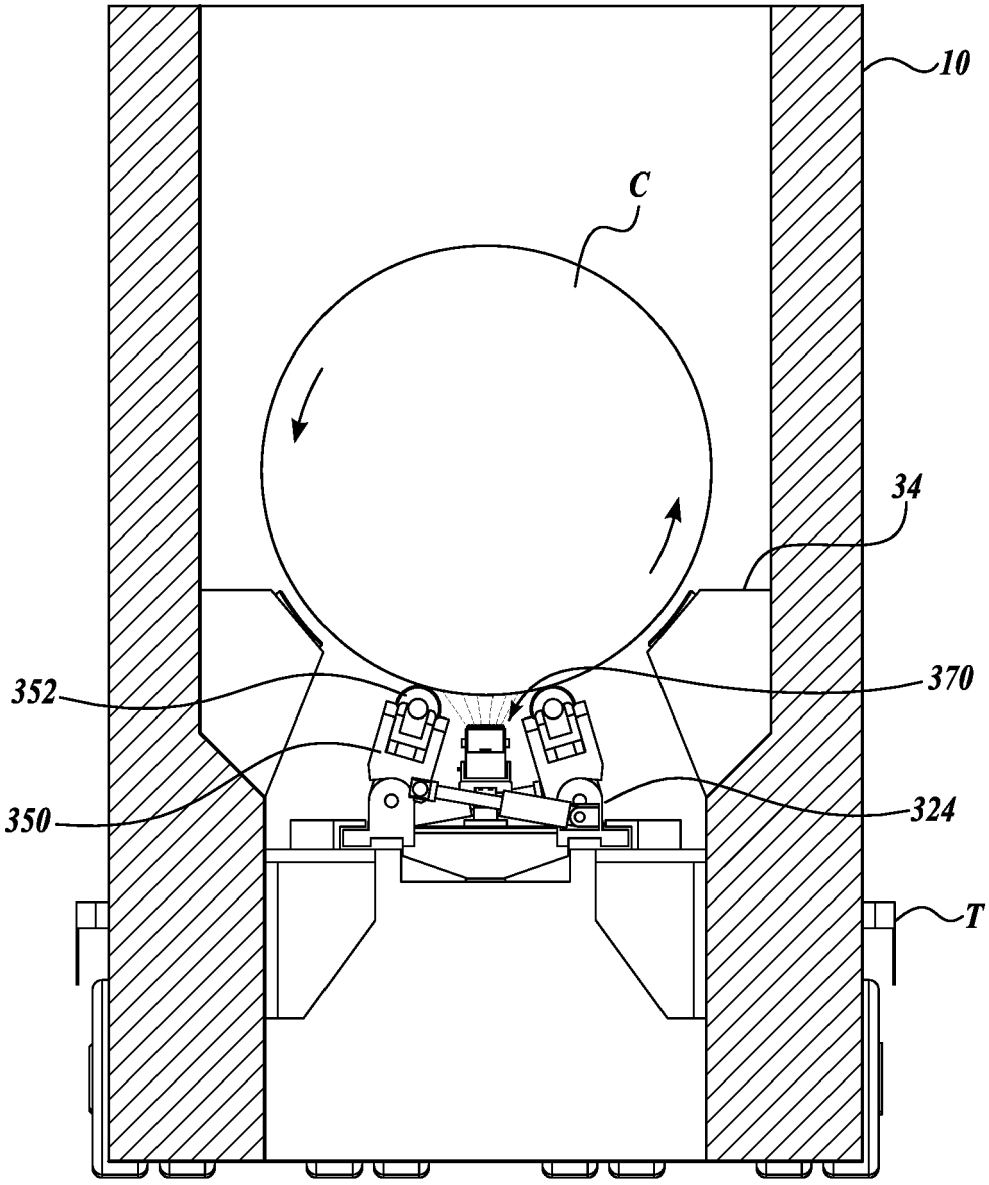


Fig. 16.

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 19 7148

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	JP 2005 331359 A (HITACHI LTD) 2 December 2005 (2005-12-02) * abstract; figures * -----	1-3, 7-12,15 4-6,13, 14	INV. G21F5/14 G21F5/00
X	US 2014/186144 A1 (SINGH KRISHNA P [US]) 3 July 2014 (2014-07-03) * abstract; figures * -----	1,10	

TECHNICAL FIELDS SEARCHED (IPC)

G21C
G21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 May 2016	Opitz-Coutureau, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 19 7148

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

31-05-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2005331359 A	02-12-2005	NONE	
US 2014186144 A1	03-07-2014	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82