(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 June 2013 (27.06.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/096011 A1

(51) **International Patent Classification:**
B65G 15/52 (2006.01) ***B65G 17/06*** (2006.01)

(21) **International Application Number:**
PCT/US20 12/068968

(22) **International Filing Date:**
11 December 2012 (11.12.2012)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
61/579,720 23 December 201 1 (23. 12.201 1) US

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title:** SORTER SLAT ATTACHMENT

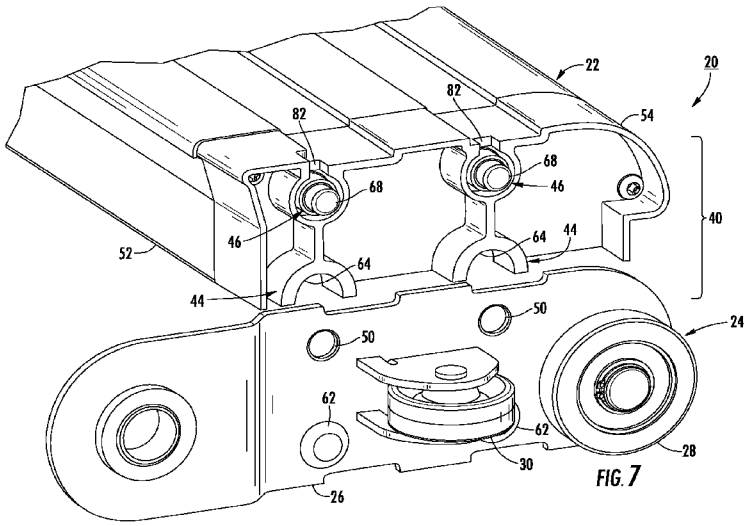


FIG. 7

(57) **Abstract:** A positive displacement sorter includes a plurality of parallel laterally extending slats and a pair of wheel assemblies, each interconnecting common end portions of the slats thereby defining an endless web that travels in a longitudinal direction. An upper surface of the web defines an article-conveying surface. A plurality of pusher shoes travel along the slats in order to laterally displace articles on the conveying surface. A plurality of attachment mechanisms are provided. Each of the attachment mechamsms attaches an end portion of one of the slats to one of the wheel assemblies. Each of the attachment mechanisms includes a shoulder and a collar and at least one locking member. The collar engages the shoulder thereby providing retention of the slat to the wheel assembly. The locking member provides retention of the collar on the shoulder.

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SORTER SLAT ATTACHMENT

BACKGROUND OF THE INVENTION

The present invention is directed to a positive displacement shoe and slat sorter and in particular to a technique for easily removing and attaching slats to wheel assemblies.

Positive displacement sorters include a large number of generally parallel slats and wheel assemblies connected to opposite ends of the slats to hold the slats together in a web and to allow the web to travel under a motive force. The wheel assemblies may include covers, known as cap angles, in order to allow articles to be diverted off of the sorter without contacting the wheel assemblies. Some installations also include guards to restrict articles from falling off of the sorter in the case of a jamb condition.

The presence of cap angles, guards, and the like, make it cumbersome to remove a slat, such as to replace a pusher shoe, access the interior of the sorter, or the like. Therefore, proposals have been made to provide a slat-mounting arrangement that allows removal and reattachment of the slats with respect to the wheel assemblies without the need to remove the cap angle and/or the guards.

SUMMARY OF THE INVENTION

The present invention provides an attachment technique for removeably attaching slats of a shoe and slat sorter to wheel assemblies in a manner that is both easy to operate and is robust in construction.

A positive displacement sorter, according to an aspect of the invention, includes a plurality of parallel laterally extending slats and a pair of wheel assemblies, each interconnecting common end portions of the slats thereby defining an endless web that travels in a longitudinal direction. An upper surface of the web defines an article-conveying surface. A plurality of pusher shoes travel along the slats in order to laterally displace articles on the conveying surface. A plurality of attachment mechanisms are provided. Each attaches an end portion of one of the slats to one of the wheel assemblies. Each of the attachment mechanisms includes a shoulder and a collar and at least one locking member. The collar engages the shoulder thereby providing retention of the slat to the wheel assembly. The locking member provides retention of the collar on the shoulder. The locking member includes a generally horizontally moveable

elongated member engaging an opening. The elongated member is on either the slat or the wheel assembly with the opening on the other of said slat or the wheel assembly.

The shoulder may be on the slat or wheel assembly and the collar on the other of the slat or wheel assembly. The shoulder may be on the wheel assembly and the collar is on the slat, with the generally horizontally moveable elongated member being on the slat and the opening on the wheel assembly.

Each of the wheel assemblies may include a generally vertical plate at each of the slats, wherein the openings and shoulder are at the generally vertical plate. The generally vertical plate may have a set of through-holes mounting the shoulder, with the through-holes being symmetrical with the locking openings. In this manner, a common configuration of the vertical plate may be used in both of the wheel assemblies.

The shoulder may include at least two spaced apart horizontally extending studs with at least two of the sockets engaging the studs. Each of the studs may include an enlarged head in order to laterally retain one of the sockets on that stud. The studs may be circular in cross section and the sockets may be semi-circular recesses.

The generally horizontally moveable elongated member may be a pin that is generally laterally moveable to engage the opening. A biasing mechanism may be provided to bias the pin into engagement with the opening. A retention fastener may be provided that passes through an opening in a neck of a cylinder and engages the pin to retain the pin in the cylinder against the bias of the biasing mechanism.

A pin retraction tool may be provided that is adapted to retract the pin from the opening to allow the associated slat to be connected to or disconnected from the wheel assembly. The locking member may be a plurality of spaced apart pins and biasing mechanisms and the pin retraction tool may have arms positioned to engage the plurality of pins to generally concurrently retract the pins from the openings. The pin retraction tool may be adapted to engage an end portion of each pin at the wheel assembly. The pin retraction tool may be adapted to engage the generally vertical plate in the wheel assembly to retract said pins from the openings. A tapered portion may be provided at each of the arms.

A method of removeably attaching a slat to a positive displacement sorter, according to an aspect of the invention, includes having attachment mechanisms

connecting slats to chain assemblies. Each attachment mechanism includes a shoulder and a collar and at least one locking member. The collar engages the shoulder thereby providing retention of the slat to one of said wheel assemblies. The locking member provides retention of the collar on the shoulder. The locking member includes a generally horizontally moveable elongated member and an opening. The method further includes horizontally retracting the elongated member from the opening and separating said collar from the shoulder to remove the slat.

A pin retraction tool may be used to retract the pin from the opening to allow the associated slat to be connected to or disconnected from the wheel assembly. The locking member may include a plurality of spaced apart pins and biasing mechanisms and the pin retraction tool having arms positioned to engage the pins and generally concurrently retracting the pins from the openings. The pin retraction tool may pivot against one of the wheel assemblies to retract the pins from the openings. An end portion of each said pin may be engaged at the wheel assembly with the pin retraction tool. The pin retraction tool may pivot about a generally vertical plate of the wheel assembly to retract the pins from the openings. A tapered end of each arm may be used to compress the pins by positioning the tapered end between the pins and wheel assembly.

A pin retraction tool that is adapted to retracting a plurality of biased pins, according to an aspect of the invention, includes a plurality of spaced apart arms that can be positioned to engage the plurality of pins generally concurrently to retract the pins from openings. A handle joins the arms. An end of each of the arms is configured to retract the pins from openings in a plate.

A pivot may be defined in the arms or handle to pivot against a top of the plate to retract the pins. An opposite end of each of the arms may be configured to match an end of one of the pins in order to retract the pins to allow the pins to be inserted in the openings.

These and other objects, advantages and features of this invention will become apparent upon review of the following specification in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a positive displacement sorter, according to an embodiment of the invention;

Fig. 2 is an enlarged perspective view of the positive displacement sorter in Fig. 1;

Fig. 3 is a top plan view of the sorter in Fig. 1;

Fig. 4 is a side elevation taken from the direction III-III in Fig. 2;

Fig. 5a is a top plan view of a left side wheel assembly;

Fig. 5b is a top plan view of a right side wheel assembly;

Fig. 6 is an enlarged top plan view of the area designated VI in Fig. 5b;

Fig. 7 is a perspective view of a slat attachment mechanism, according to an embodiment of the invention, with the slat separated from the wheel assemblies;

Fig. 8 is the same view as Fig. 7 with the slat almost attached to the wheel assembly;

Fig. 9 is a sectional view taken along the lines IX -IX in Fig. 4 showing the shoulders supporting the sockets;

Fig. 10 is a sectional view taken along the lines X-X in Fig. 4 showing the locking pins in an extended position;

Fig. 11 is a perspective view of a pin retraction tool;

Fig. 12 shows a pin retraction tool juxtaposed with the slat attachment mechanism;

Fig. 13 shows the pin retraction tool being operated to retract the locking pins to remove the slat from the wheel assembly;

Fig. 14 is a perspective view showing the pin retraction tool being used to retract the pins in order to connect a slat to the wheel assembly;

Fig. 15 is a sectional view taken along the lines XV-XV in Fig. 12;

Fig. 16 is a sectional view taken along the lines XVTXVI in Fig. 13; and

Fig. 17 is a sectional view taken along the lines XVITXVII in Fig. 14;

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and the illustrative embodiments depicted therein, a positive displacement sorter 20 includes a plurality of parallel laterally

extending slats 22 and a pair of wheel assemblies 24. Each wheel assembly interconnects common end portions of slats 22 thereby defining an endless web 32 that travels in a longitudinal direction, shown as the direction of travel in Fig. 1. It should be understood that the other wheel assembly (Fig. 5a) is a mirror image of the one shown in Fig. 5b and interconnects the opposite end portions of the slats. An upper surface of web 32 defines an article-conveying surface 34. A plurality of pusher shoes 36 each travel along one or more of slats 22 in order to laterally displace articles (not shown) on conveying surface 34. Sorter 20 includes a propulsion device for web 32, diverting gates and rails for pusher shoes 36.

Each wheel assembly 24 includes a plurality of interconnected vertical link plates 26, each associated with one slat 22, vertical wheels 28 that allow endless web 32 to travel in the longitudinal direction and a plurality of horizontal side thrust wheels 30 that resist lateral, or sideward, movement of endless web 32. Link plates 26 are interconnected by the axles for vertical wheels 28. A cover, such as a capture angle 38, covers wheel assembly 24 and restrains vertical wheels 28 from rising significantly above their lower support surface 39. It should be understood that the techniques disclosed herein are equally useful with sorter wheel assemblies utilizing chains connected with the slats to propel the web.

Sorter 20 includes a plurality of attachment mechanisms 40, each attaching an end portion of one of slats 22 to one of wheel assemblies 24. Each of attachment mechanisms 40 includes a shoulder, generally shown at 42, a collar, generally shown at 44 and at least one locking member generally shown at 46. As will be explained in more detail below, collar 44 engages shoulder 42 thereby providing retention of an end of a slat 22 to said one of wheel assemblies 24 while locking member(s) 46 provides retention of collar 44 on shoulder 42. In the illustrated embodiment, locking member 46 includes a generally horizontally moveable elongated member 48 that engages an opening 50 in order to retain collar 44 on shoulder 42, particularly when the slat is either travelling upside down or experiencing centripetal forces when rounding an end of the sorter. Otherwise, shoulder 42 on collar 44 provides sufficient strength to carry the load on the slat from articles being sorted by sorter 20 on article-conveying surface 34, by a maintenance technician standing on article-conveying surface 34, or the like.

In the illustrated embodiment, locking member(s) 46 are on slat 22 and openings 50 being defined in a corresponding link plate 26 of one of wheel assemblies 24. However, it may be possible to provide locking member 46 on link plate 26 engaging an opening 50 on the slat.

Shoulder 42 is on either wheel assembly 24, with collar 42 on slat 22, or *vice versa.* In the illustrated embodiment, shoulder 42 is mounted to a link plate 26 of a wheel assembly 24 and collar 44 is on slat 22. In this manner, collar 44 and opening(s) 50 provide a wheel assembly portion of attachment mechanism 40, while collar 44 and elongated member(s) 48 define a slat portion of attachment mechanism 40. In the illustrated embodiment, a vertical link plate 26 is provided at each of said slats and has set of through-holes 51 that are provided to mount collar 44. Through-holes 51 are symmetrical with opening(s) 50. This provides a common configuration of vertical plate 26 which can be used in both wheel assemblies merely by reversing the plates, as would be apparent to the skilled artisan.

Each slat 22 is made up of an elongated extrusion 52, such as an aluminum extrusion made by commonly available extrusion or pul-trusion techniques, and a generally polymeric slat extension 54 engaging the end portion of elongated extrusion 52, wherein elongated member(s) 48 and collar 44 are a part of slat extension 54.

In the illustrated embodiment, shoulder 42 is made up two or more spaced apart horizontally extending studs 62 and collar 44 is made up of a corresponding number of sockets 64 that are configured to engage studs 62. Each stud 62 is circular in cross section and includes an enlarged head 66. Each stud 62 may be rigidly connected with its through-hole 51 by swaging, welding, or the like, as best seen in Fig. 9. Sockets 64 define a semi-circular recess that fits over enlarged head 66 in order to laterally retain the corresponding one of sockets 64 on that stud. In this manner, the engagement between shoulder 42 and collar 44 carries the weight of the slats and any load placed on article-conveying surface 34 and resists any lateral forces tending to separate the slat laterally from the wheel assembly. In this manner, the function of locking member 46 is to carry the weight of the slat when at a lower run of web 32 or at a transition between upper and lower runs of the web at the ends of sorter 20, as well as to ensure that collar 44 is kept in engagement with shoulder 42.

Elongated member(s) 48 is generally laterally moveable with respect to slats 22 in order to engage opening(s) 50. As best seen in Fig. 10, in the illustrated embodiment, each elongated member 48 is made up of a pin 68 and a biasing mechanism, such as a compression spring 70 that biases pin 68 into engagement with opening 50. A retention fastener 72 passes through an opening in a neck 76 of a cylinder 74, in which both pin 68 and biasing mechanism 70 reside, and engages pin 68 to retain the pin in cylinder 74 against the bias of biasing mechanism 70.

Pins 68 may be retracted by a variety of techniques in order to either separate a slat 22 from wheel assemblies 24 or return the slat to the mounted configuration. In the illustrated embodiment, slat extension 54 is made almost entirely from a structural plastic such as polypro long glass reinforced polymer that is formed by molding, although other materials may be used. Pins 68 move in bronze sleeves 69 to provide durability and lubrication. Pins 68 have tapered ends which taper such that the diameter at a distal end is less than the diameter of openings 50 and increase in diameter inwardly to a proximal diameter that forms an interference fit with openings 50. This provides ease of insertion of the pins while ensuring a movement-free attachment of the slats to the wheel assembly. Also, each pin 68 includes a dimple 69 at its end for engagement by a pin retraction tool 80.

Pin retraction tool 80 actuates the pins 68 from outside of link plate 26 of wheel assembly 24 (Fig. 11). Also, retraction tool 80 is configured to retract two pins at a time, but could be configured to retract one pin at a time. Pin retraction tool 80 includes a handle 92 at one end and an engagement end 83 that is configured to engage the ends of two pins 68. Retraction tool 80 additionally includes a pivot 85. Pivot 85 pivots against link plate 26 in an indent or recess 82 in slat 22. Recess 82 allows pivot 85 to sufficiently engage the inner surface of link plate 26 in order to have sufficient leverage to compress pins 68. However, recess 82 does not need to open into the interior of slat extension 54 so does not provide a conduit for debris to enter the slat extension. Tool 80 additionally includes a finger 87 to retract a pin 68.

In use, the operator rests pivot 85 against link plate 26 in recess 82, which aligns engaging end 83 with the corresponding pin 68 as shown in Figs 12 and 15. The operator then pivots handle 92 laterally outwardly, as seen in Figs. 13 and 16 which

retracts the pin, thereby allowing that end of the slat to be elevated sufficiently for the pin to move past opening 50 so that it stays retracted against the link plate. This process is repeated for the other end of the slat. The slat can then be removed by lifting upwardly. An end of handle 92 could have a tapered end 93 in order to compress a pin against link plate 126 to reinstall the slat, as seen in Figs. 14 and 17. It should be apparent from the illustrations in Figs. 12-17 that the slat can be removed by inserting pin retraction tool 80 between link plate 26 and cover or cap angle 38. Therefore, the slat can be removed without removing cover 38.

While the foregoing description describes several embodiments of the present invention, it will be understood by those skilled in the art that variations and modifications to these embodiments may be made without departing from the spirit and scope of the invention, as defined in the claims below. The present invention encompasses all combinations of various embodiments or aspects of the invention described herein. It is understood that any and all embodiments of the present invention may be taken in conjunction with any other embodiment to describe additional embodiments of the present invention. Furthermore, any elements of an embodiment may be combined with any and all other elements of any of the embodiments to describe additional embodiments.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A positive displacement sorter, comprising:

a plurality of parallel laterally extending slats and a pair of wheel assemblies, each interconnecting common end portions of said slats thereby defining an endless web that travels in a longitudinal direction, an upper surface of said web defining an article-conveying surface;

a plurality of pusher shoes, each of said shoes travelling along at least one of said slats in order to laterally displace articles on said conveying surface; and

a plurality of attachment mechanisms, each attaching an end portion of one of said slats to one of said wheel assemblies, wherein each of said attachment mechanisms comprises a shoulder and a collar and at least one locking member, said collar engaging said shoulder thereby providing retention of said slat to said one of said wheel assemblies, said locking member providing retention of said collar on said shoulder, wherein said locking member comprises a generally horizontally moveable elongated member on one of said slat and said one of said wheel assemblies engaging an opening on the other of said slat and said one of said wheel assemblies.

2. The sorter as claimed in claim 1 wherein one of said shoulder and said collar are defined on said one of said wheel assemblies and the other of said shoulder and said collar are defined on said slat.

3. The sorter as claimed in claim 1 or claim 2 wherein said shoulder is on said one of said wheel assemblies and said collar is on said slat and wherein said generally horizontally moveable elongated member is on said slat and said opening is on said one of said wheel assemblies.

4. The sorter as claimed in claim 1 wherein each of said wheel assemblies comprises a generally vertical plate at each of said slats and wherein said openings and said shoulder are at said generally vertical plate.

5. The sorter as claimed in claim 4 wherein said generally vertical plate has a set of through-holes mounting said shoulder, wherein said through-holes are symmetrical with said openings wherein a common configuration of said vertical plate is used in both of said wheel assemblies.

6. The sorter as claimed in claim 1 wherein said shoulder comprises at least two spaced apart horizontally extending studs with at least two said sockets engaging said studs.

7. The sorter as claimed in claim 6 including an enlarged head on each of said studs in order to laterally retain one of the sockets on that stud.

8. The sorter as claimed in claim 7 wherein said studs are circular in cross section and said sockets comprise semi-circular recesses.

9. The sorter as claimed in claim 1 wherein said generally horizontally moveable elongated member comprises a pin that is generally laterally moveable to engage said opening.

10. The sorter as claimed in claim 9 including a biasing mechanism biasing said pin into engagement with said opening.

11. The sorter as claimed in claim 10 including a retention fastener that passes through an opening in a neck of a cylinder and engages said pin to retain said pin in said cylinder against said biasing mechanism.

12. The sorter as claimed in any of claims 9 through 11 including a pin retraction tool that is adapted to retract said pin from said opening to allow the associated slat to be connected to or disconnected from said one of said wheel assemblies.

13. The sorter as claimed in claim 12 wherein said locking member comprises a plurality of spaced apart pins and biasing mechanisms and wherein said pin retraction tool has arms positioned to engage said plurality of pins to generally concurrently retract said pins from said openings.

14. The sorter as claimed in claim 13 wherein said pin retraction tool is adapted to pivot against one of said wheel assemblies to engage an end portion of each said pin at said wheel assembly to retract said pins from said openings.

15. The sorter as claimed in claim 14 wherein said pin retraction tool includes a pivot that is adapted to engage a generally vertical plate in the wheel assembly to retract said pins from said openings.

17. A method of removeably attaching a slat from a positive displacement sorter having a plurality of parallel laterally extending slats and a pair of wheel assemblies, each interconnecting common end portions of said slats thereby defining an endless web that travels in a longitudinal direction, an upper surface of said web defining an article-conveying surface and a plurality of pusher shoes, each of said shoes travelling along at least one of said slats in order to laterally displace articles on said conveying surface, and an attachment mechanism attaching an end portion of one of said slats to one of said wheel assemblies, said method comprising:

each of said attachment mechanisms comprises a shoulder and a collar and at least one locking member, said collar engaging said shoulder thereby providing retention of said slat to said one of said wheel assemblies, said locking member providing retention of said collar on said shoulder, wherein said locking member comprises a generally horizontally moveable elongated member on one of said slat and said one of said wheel assemblies engaging an opening on the other of said slat and said one of said wheel assemblies; and

horizontally retracting said elongated member from said opening and separating said collar from said shoulder.

18. A pin retraction tool that is adapted to retracting a plurality of biased pins from openings in a plate, said pins and said plate attaching a slat of a sorter, said tool comprising:

a plurality of spaced apart arms that can be positioned to engage a plurality of pins generally concurrently to retract the pins from openings;

a handle that joins said arms; and

an end of each of said arms configured to retract the pins from openings in a plate, said end including a pivot defined in said arms to pivot against a top of the plate to retract the pins.

19. The pin retraction tool as claimed in claim 18 wherein an opposite end of each of said arms is configured to match an end of one of said pins in order to retract the pins to allow the pins to be inserted in the openings.

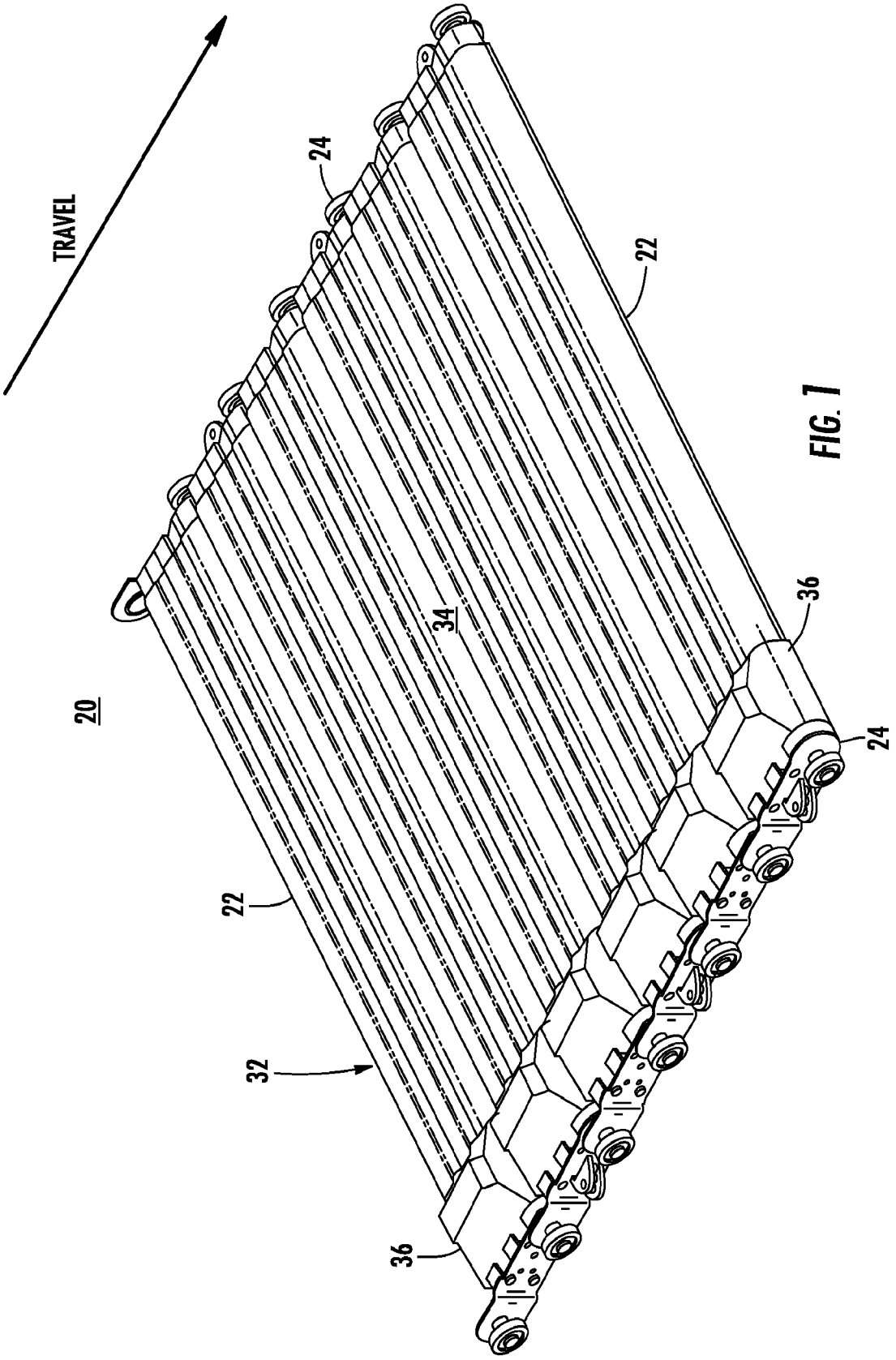


FIG. 1

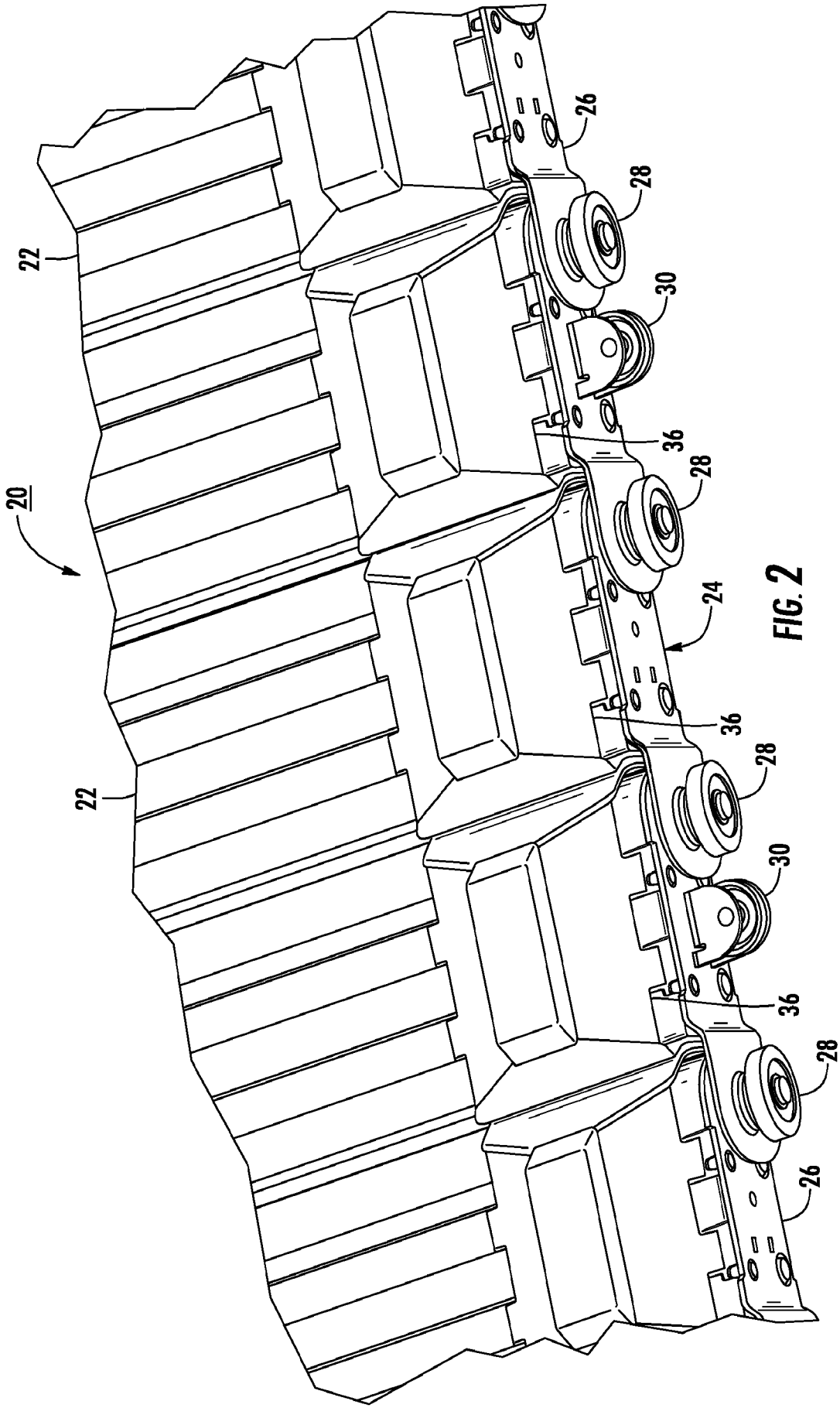


FIG. 2

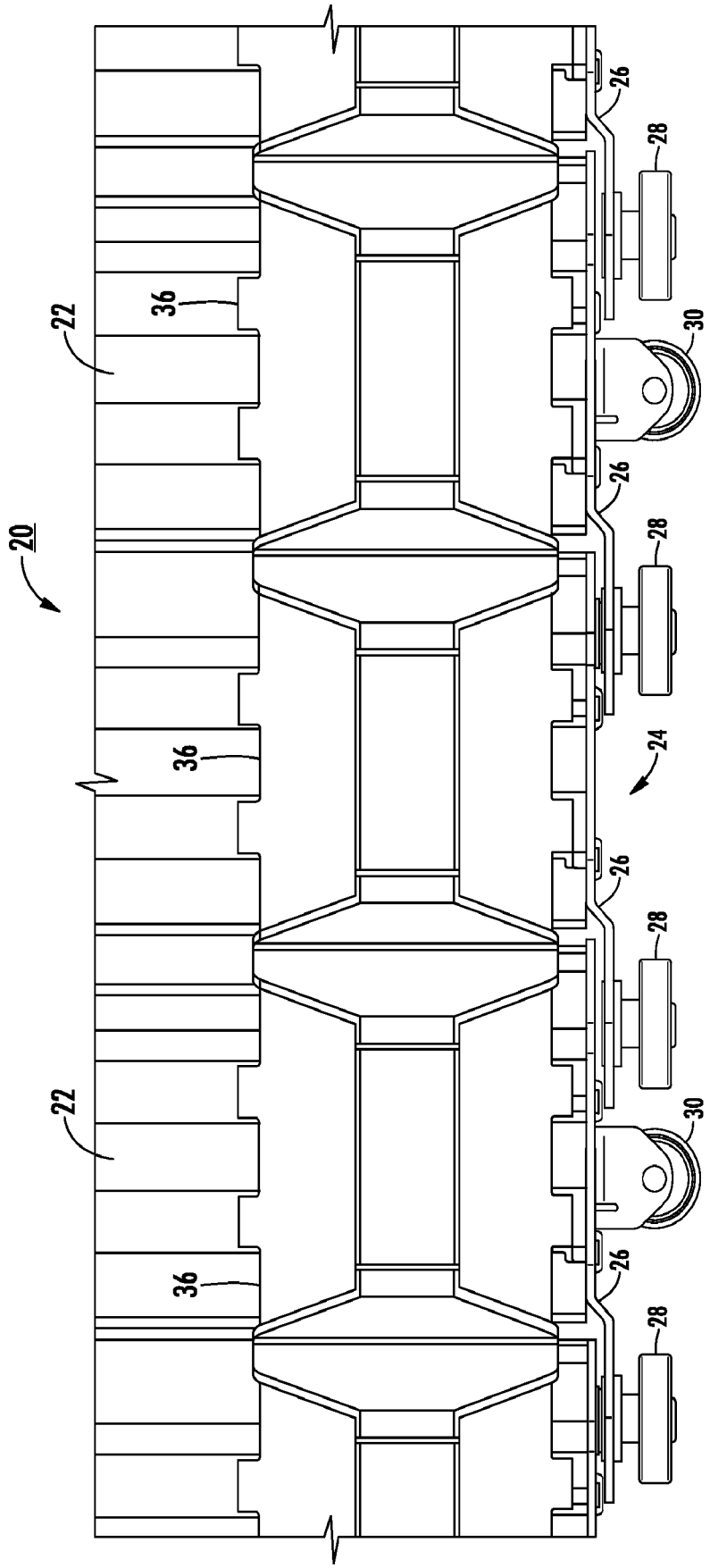


FIG. 3

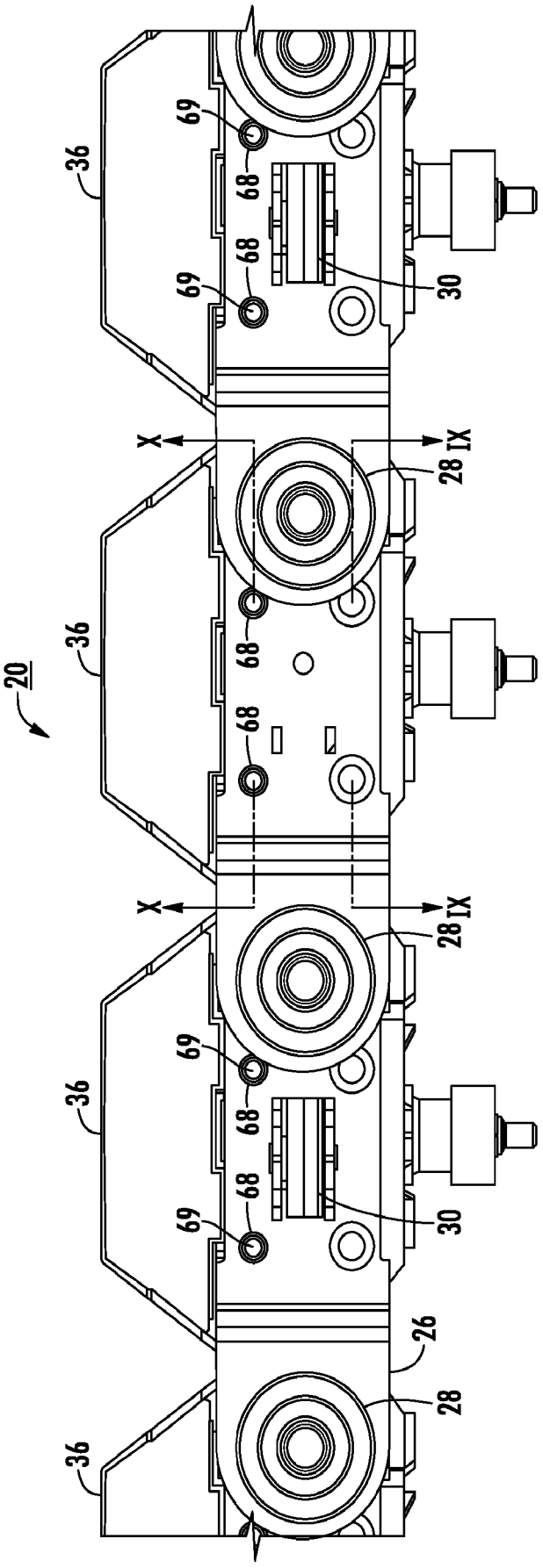


FIG. 4

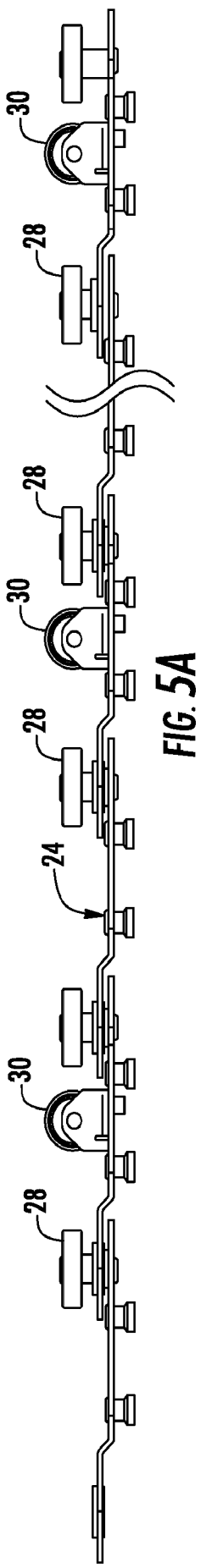


FIG. 5A

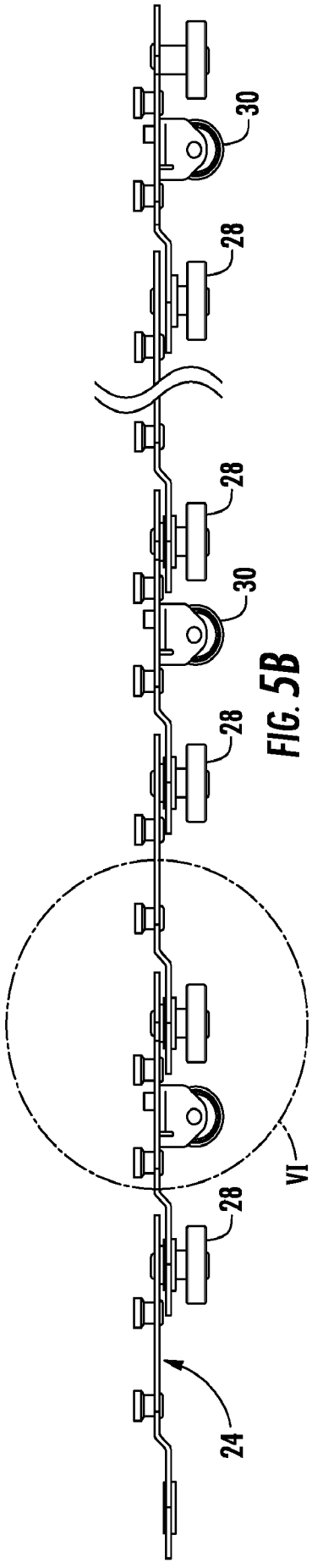


FIG. 5B

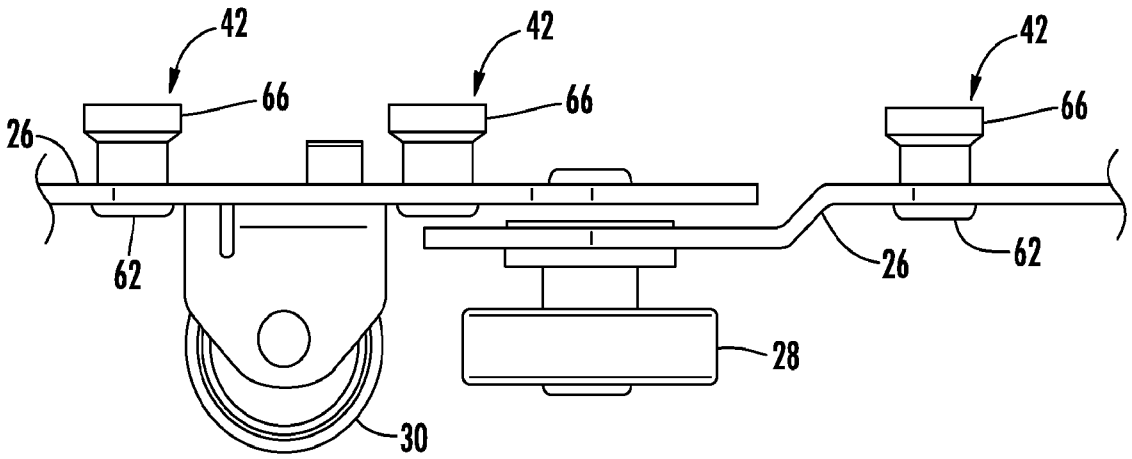


FIG. 6

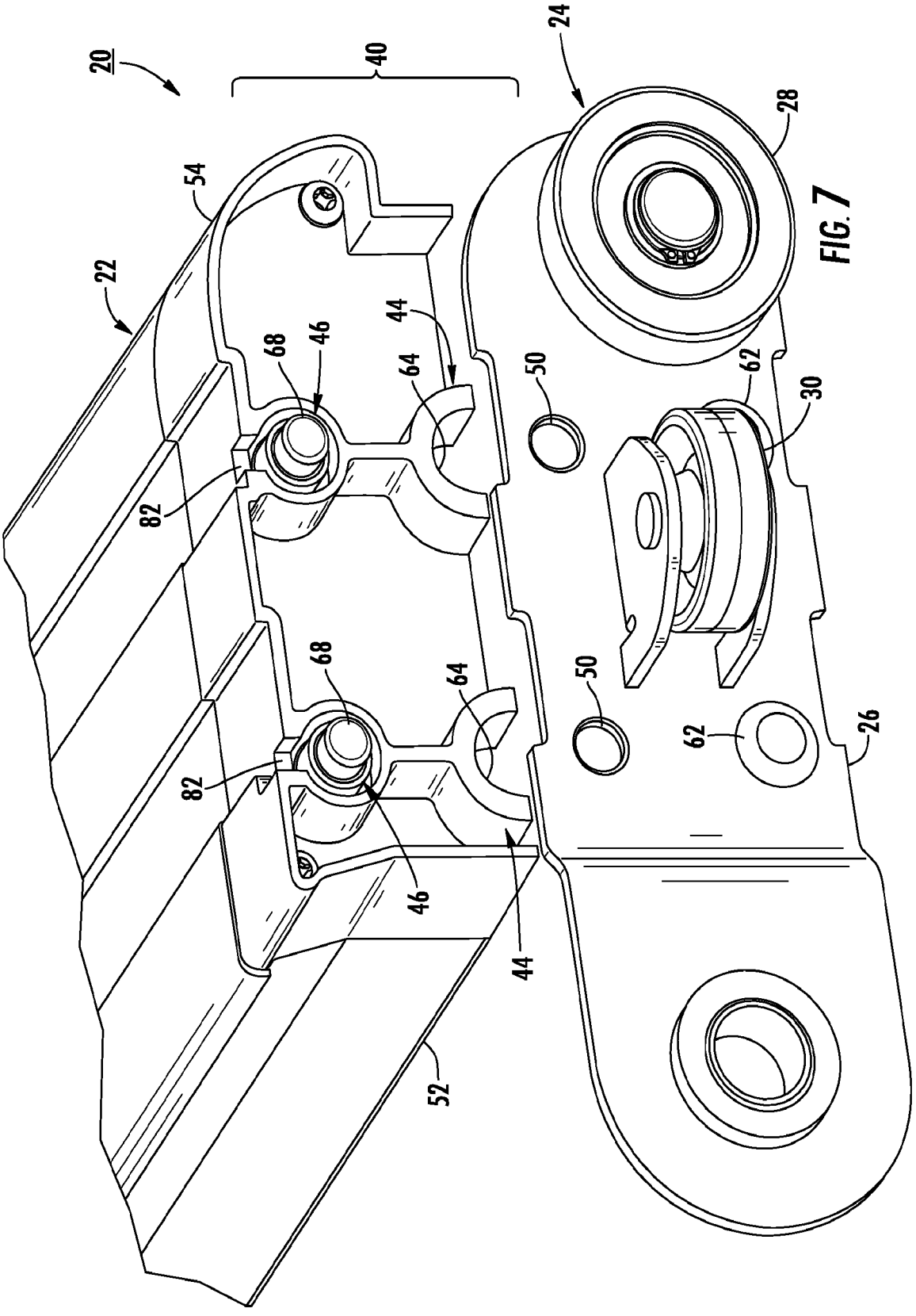


FIG. 7

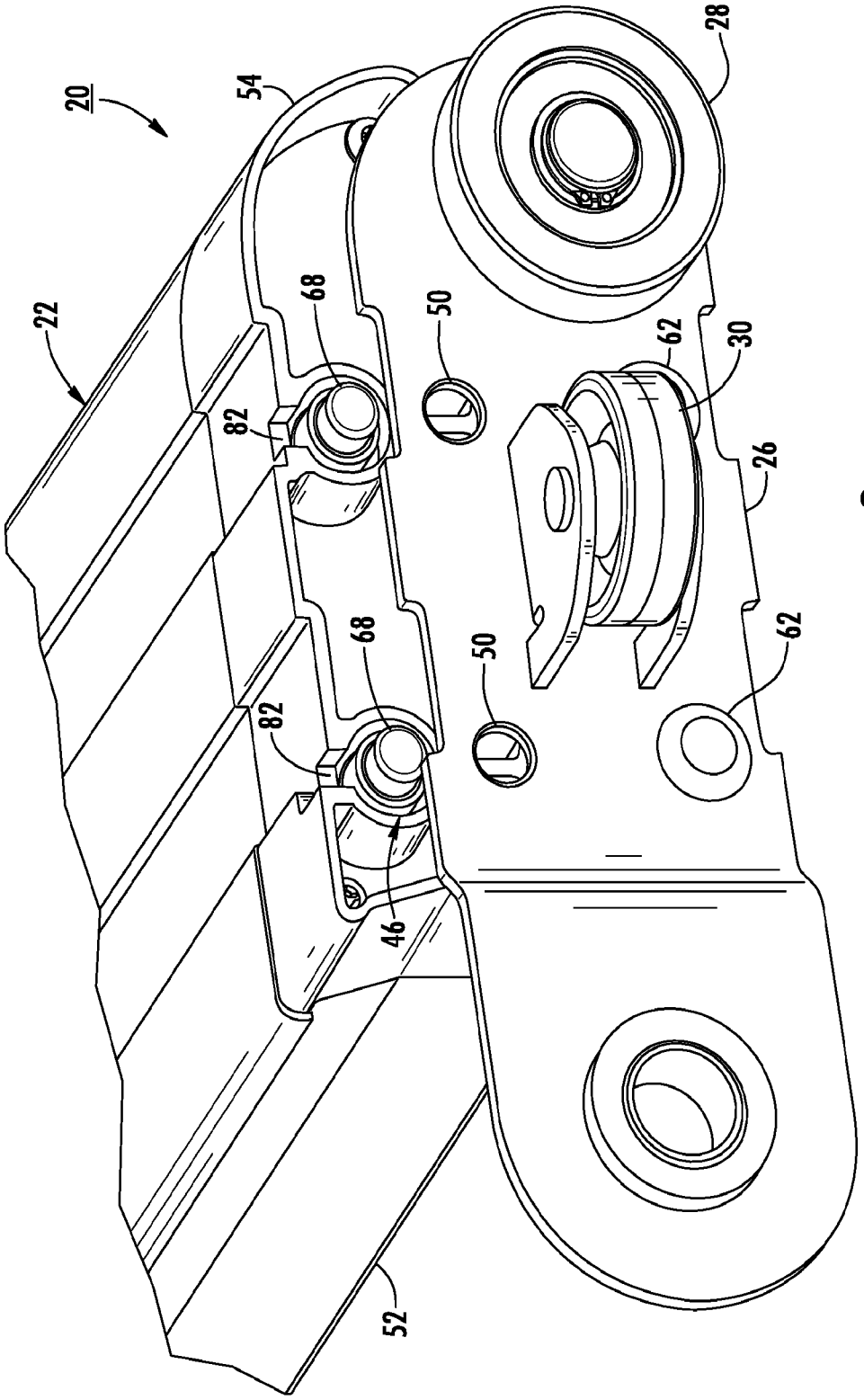


FIG. 8

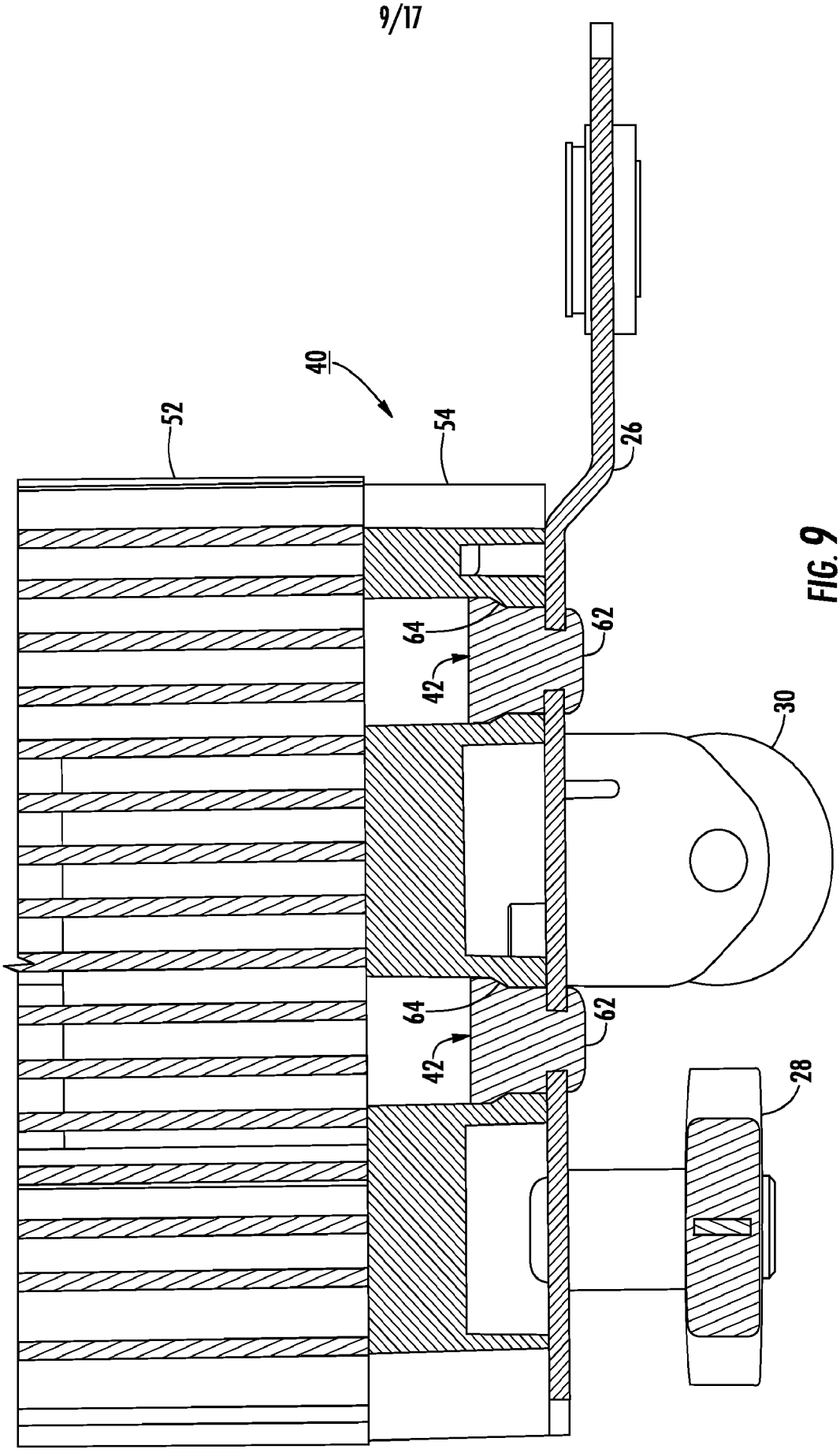


FIG. 9

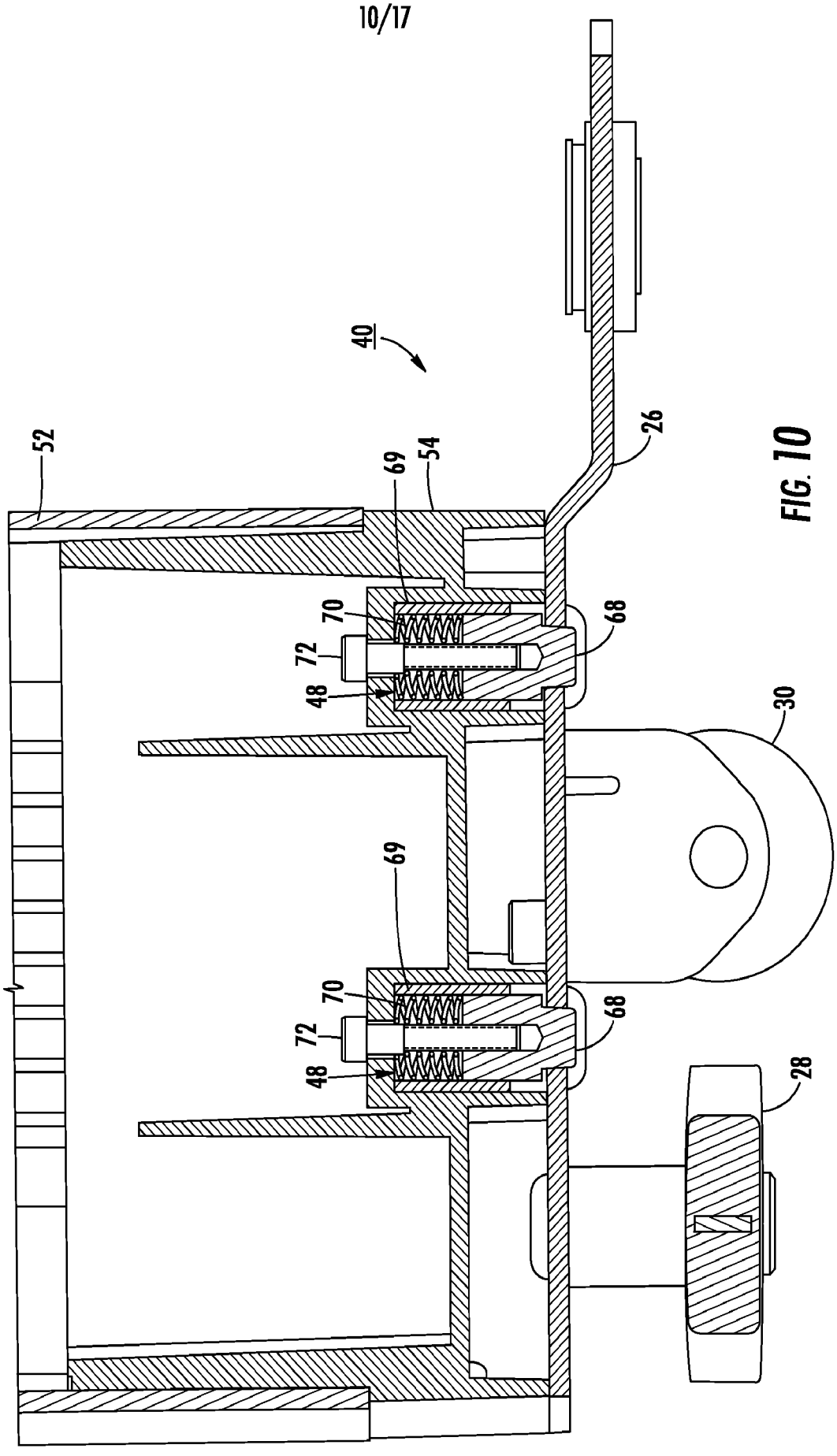


FIG. 10

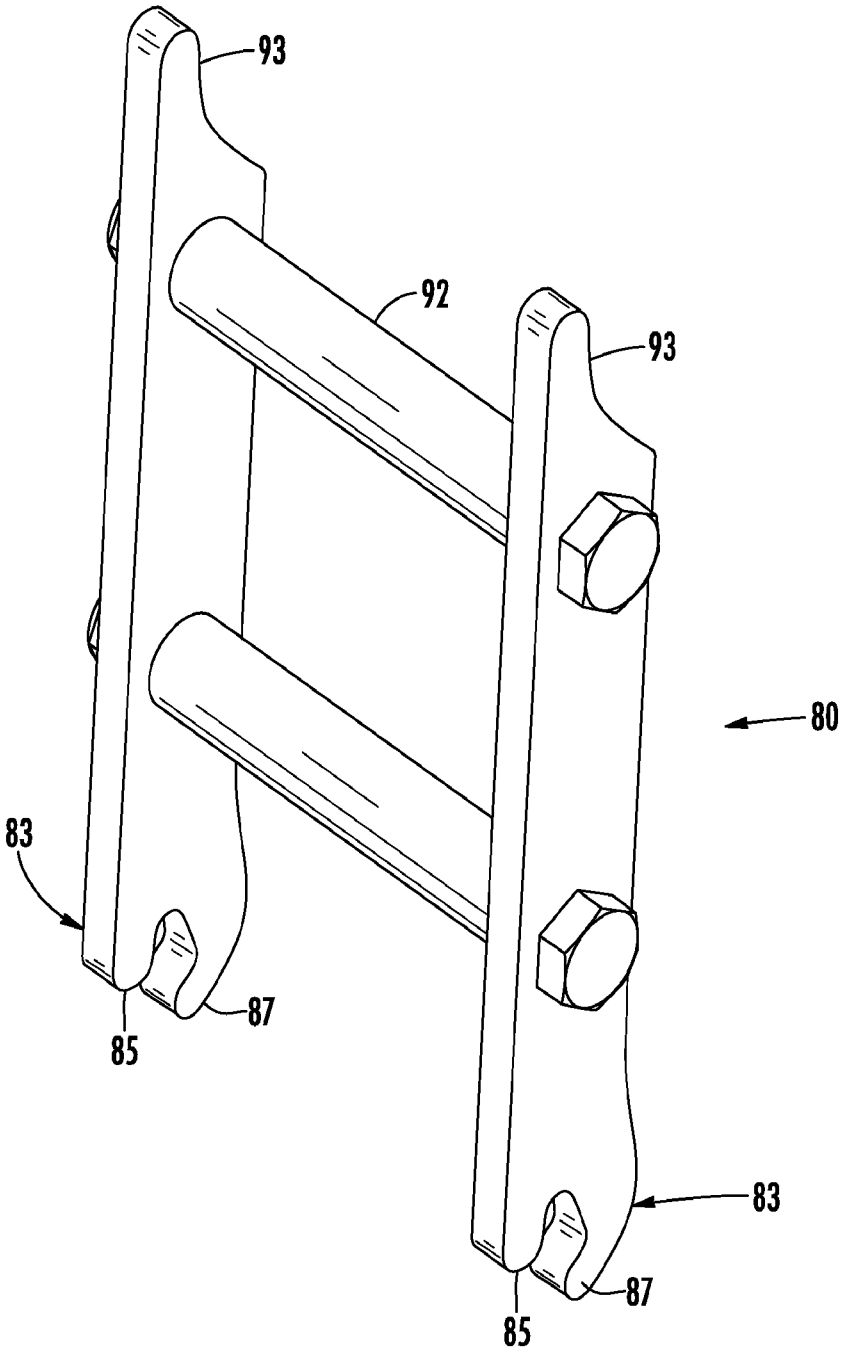


FIG. 11

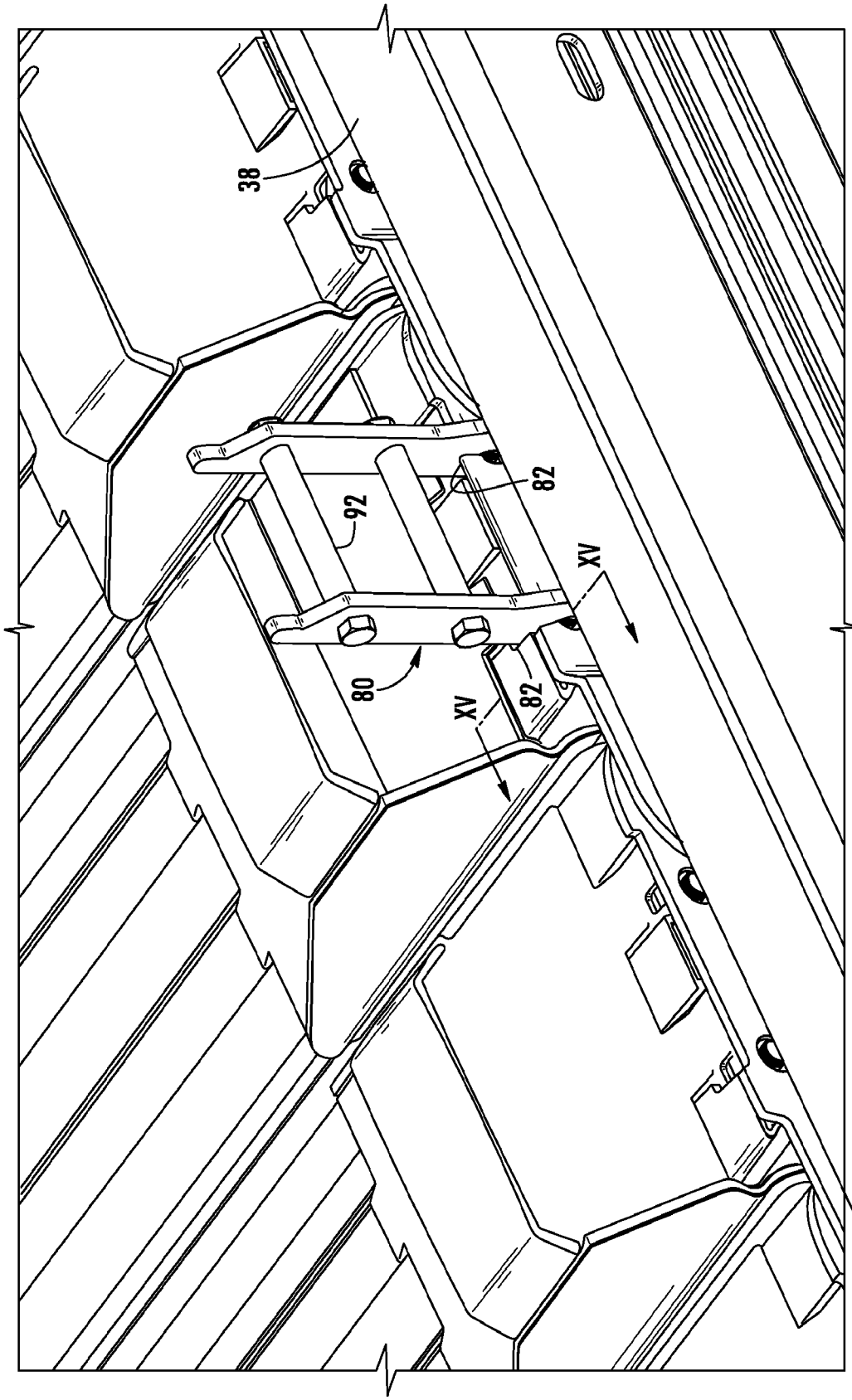


FIG. 12

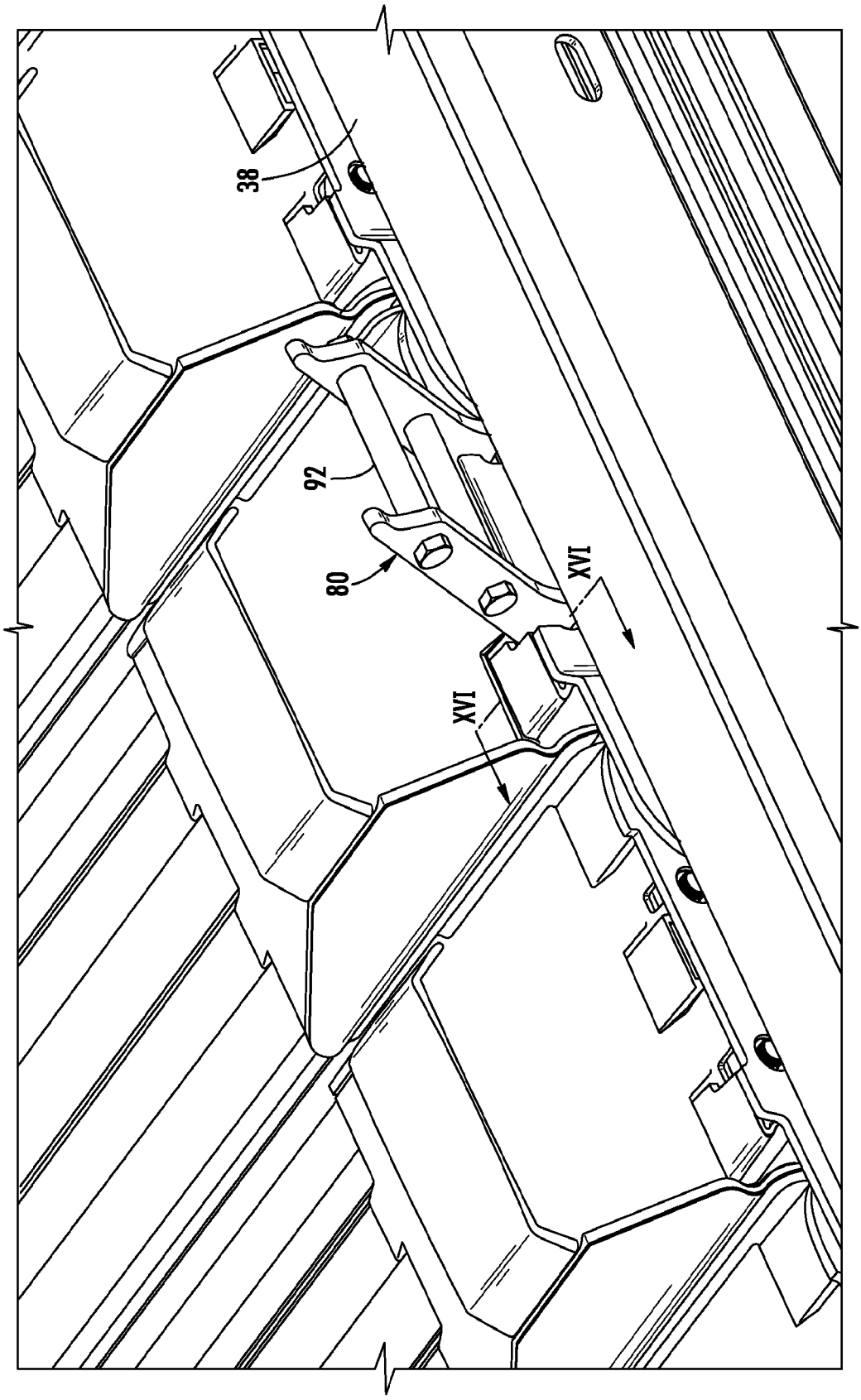
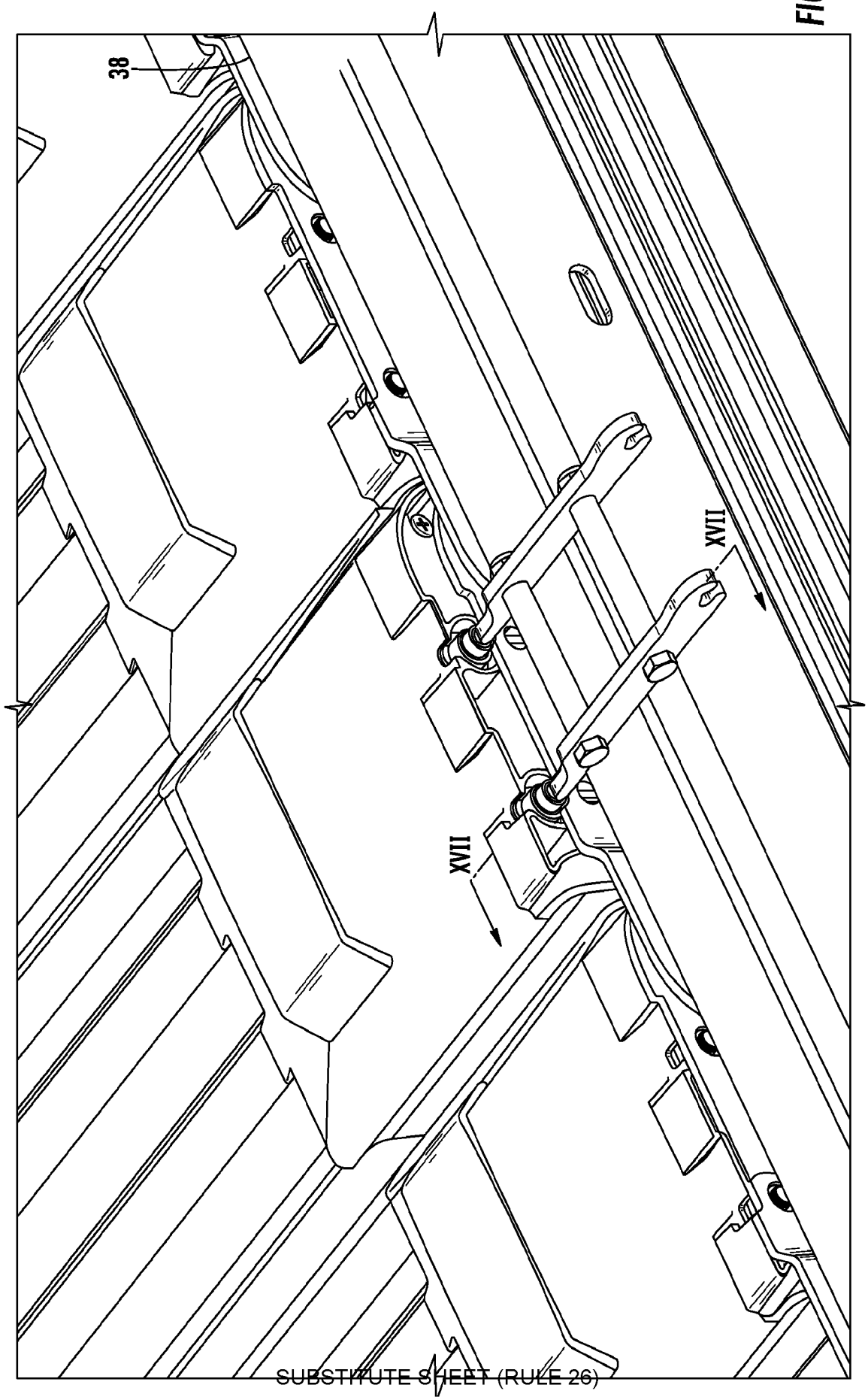


FIG. 13

FIG. 14



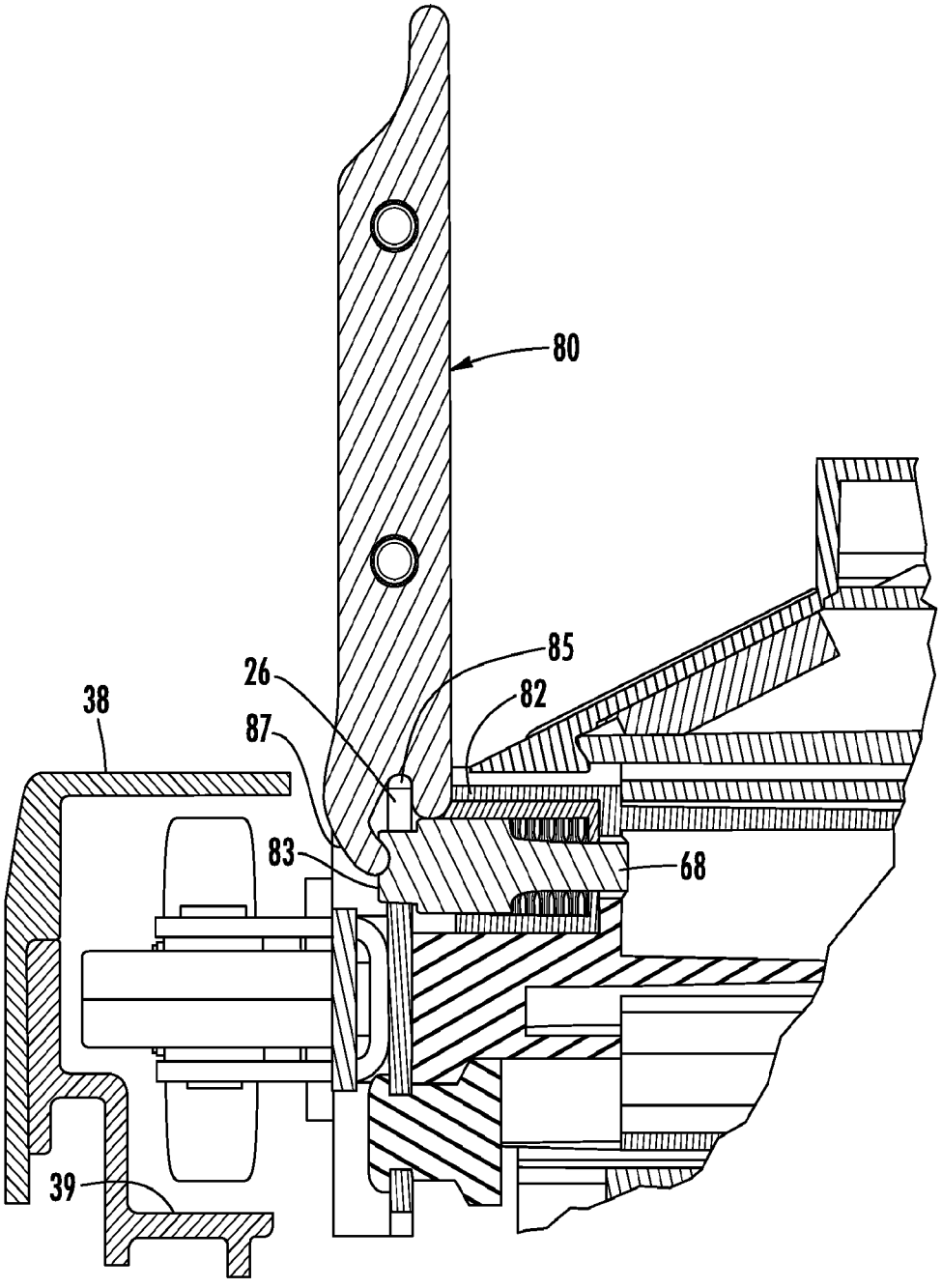


FIG. 15

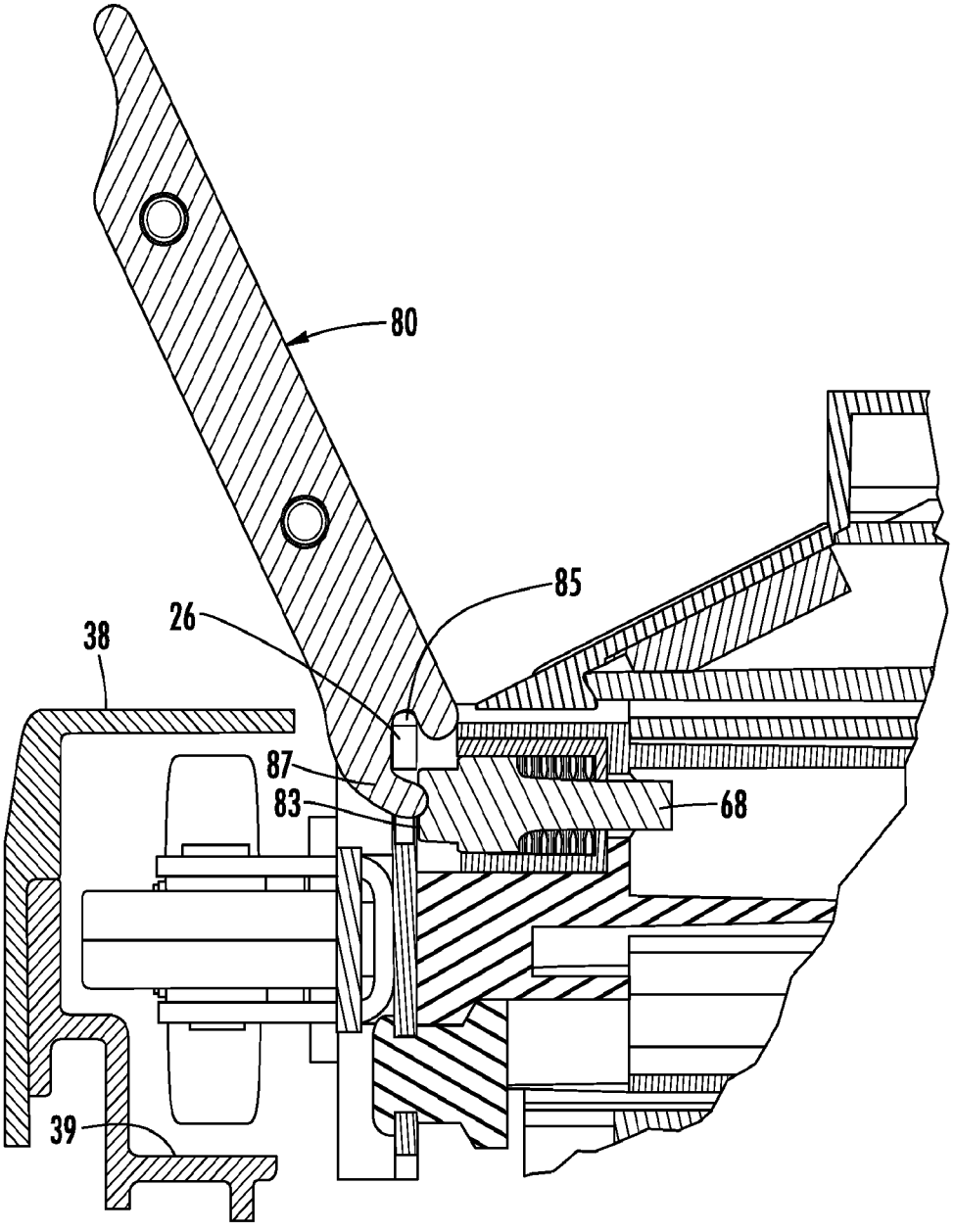


FIG. 16

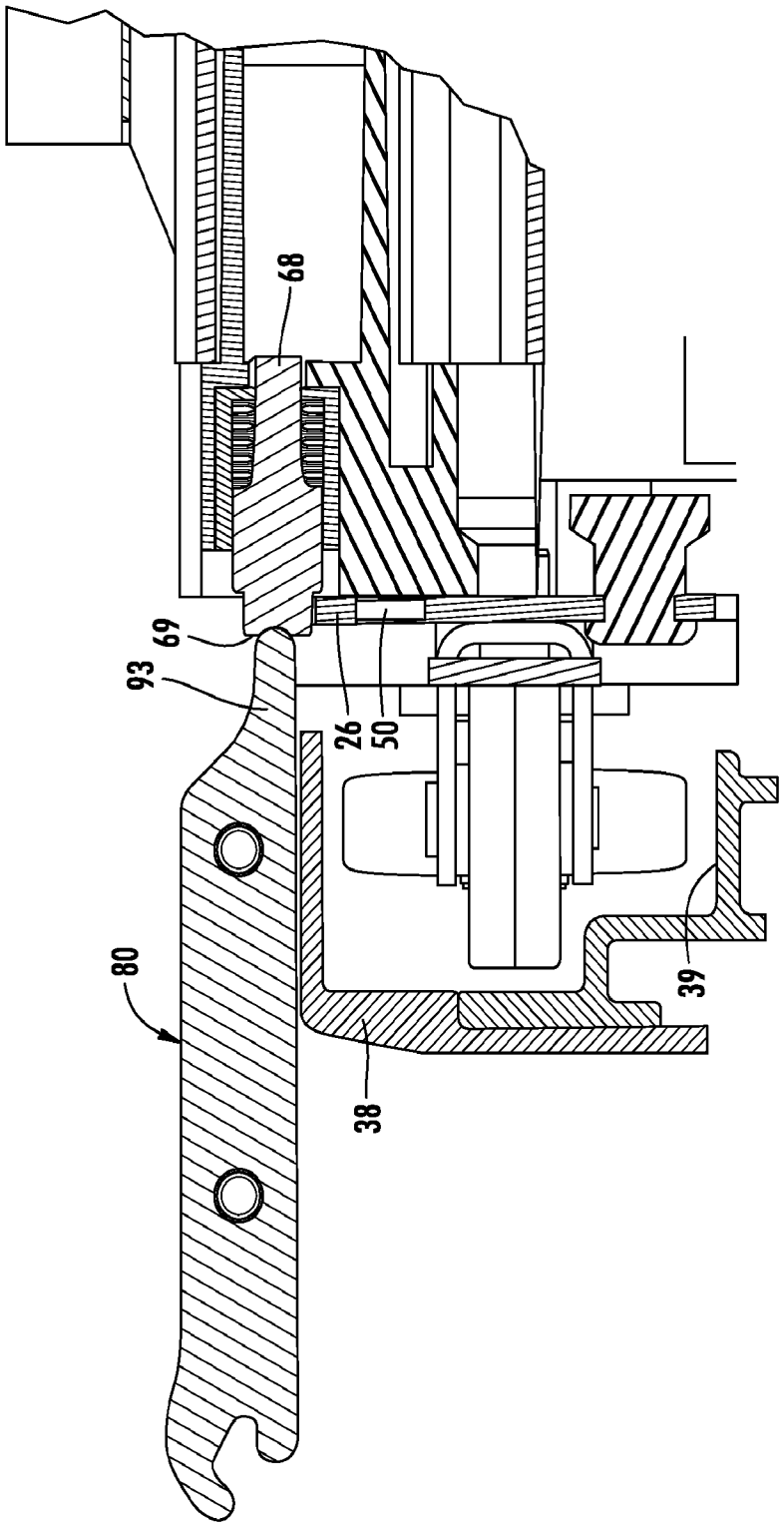


FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/68968

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B65G 15/52, 17/06 (2013.01)
USPC - 198/844.1, 845, 849, 850, 851
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8): B65G 15/50, 15/52, 17/06, 17/24, 21/22, 39/02, 41/02 (2013.01)
USPC: 198/698, 699, 844.1, 845, 849, 850, 851, 853; D34/29

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

MicroPatent (US Granted, US Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); DialogPro (Derwent, INSPEC, NTIS, PASCAL, Current Contents Search, Dissertation Abstracts Online, Inside Conferences); Google.com/Scholar; Google.com; DialogPro; wheel *; roll*5; assembl*; plate*1; link*; bracket*; spring*3; bias*; pin; post; stud;

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/0096417 A1 (VEIT, F., et al.) July 25, 2002; abstract; figures 1, 4, 7; paragraphs [0024], [0086]-[0089]	1-6, 9, 17
Y		10-12
X	US 2,680,003 A (FEINSTEIN LE) June 1, 1954; figure 1; column 1, lines 10-20 and lines 35-50	18, 19
Y	US 4,089,408 A (VANDERHOOF FB) May 16, 1978; figure 1; column 1, lines 15-20 and lines 60-68; column 2, lines 1-25	10-12
A	US 2005/0016821 A1 (KRISL M) January 27, 2005; figure 4; paragraph [0007]	7
A	US 5,590,758 A (WILKINS, J., et al.) January 7, 1997; figure 3; column 3, lines 5-20	10-12
A	US 4,770,291 A (SHAW DW) September 13, 1988; figure 5; column 3, lines 20-25	6
A	US 4,123,947 A (SMITH, L., et al.) November 7, 1978; figure 5; column 3, lines 55-65	12-14, 18, 19

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 February 2013 (12.02.2012)	12 MAR 2013

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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