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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 August 2020 (20.08.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/165553 A1

(51) International Patent Classification:
B66C 1/10 (2006.01) *B65D 88/12* (2006.01)
B66C 15/00 (2006.01) *B65D 90/00* (2006.01)

(21) International Application Number:
PCT/GB2020/000014

(22) International Filing Date:
11 February 2020 (11.02.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1902005.6 13 February 2019 (13.02.2019) GB
PCT/GB2019/000067 08 May 2019 (08.05.2019) GB
1915555.5 25 October 2019 (25.10.2019) GB

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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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,

(54) Title: RIG, CORNER UNIT

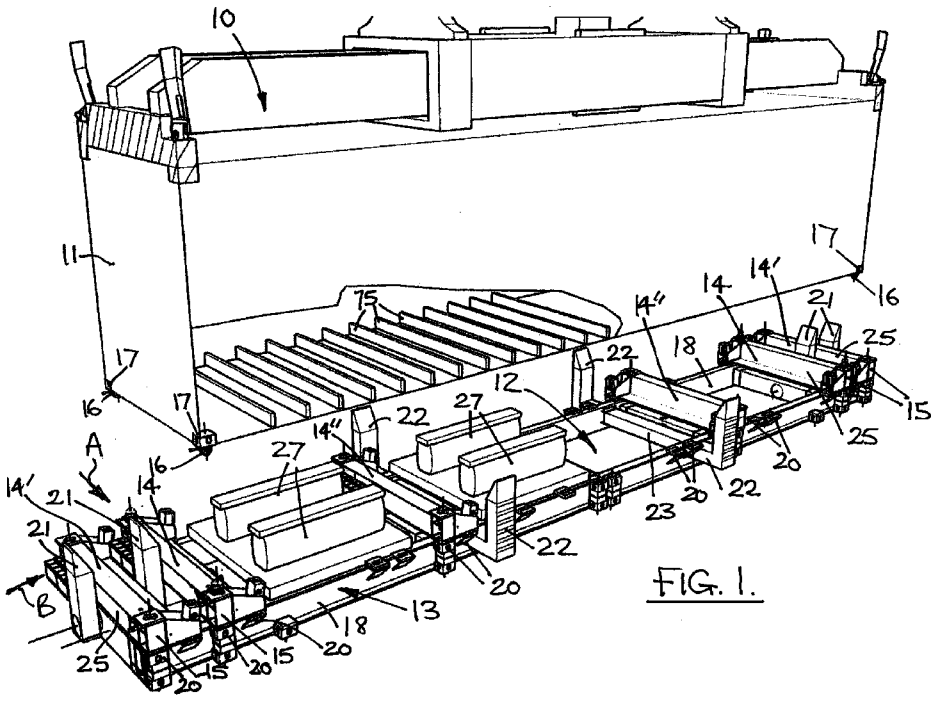

FIG. 1.

(57) Abstract: A rig for connecting or disconnecting container couplers to or from the four lower corner fittings of a shipping container, the rig has two pairs of corner units held in the required transverse special relationship by a structure extending between the two corner units of each pair to form two operating end modules. A base member has sockets and/or other connectors to secure the operating end modules in a plurality of longitudinal special relationships to enable the corner units of the modules to simultaneously engage all the four lower corner fittings of a range of containers of different lengths or using different types of couplers. Each corner unit includes an indexing means for engaging and manipulating an associated coupling to connect or disconnect the coupling to or from its associated container corner fitting.

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MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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, ST, 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, KM, ML, MR, NE, SN, TD, TG).

Published:

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

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

RIG, CORNER UNIT

In the field of shipping containers couplers are used for locating and locking each of the four bottom corner fittings of a container either to the corner fittings of another container or to structure below it. These couplers come in various designs all compatible in size with the elongate apertures to be found in the horizontal faces of the corner fittings of a typical shipping container. A common coupler is one called a semi-automatic twistlock or 'SAT'. This has an elongate head and tail joined by a shaft which rotate within an elongate collar. The rotation is needed to, for example, lock both head and tail inside the corner fittings of upper and lower containers to hold them together. The elongate head of the SAT described is known to be of a ridged conical shape such that when a corner fitting of a container with known bottom sockets is lowered onto the head with its head rotated out of its open position the head is driven by the action of the sides of the socket acting on the ridges causing the head to rotate to align longitudinally with the elongate socket and easily enter the socket where upon it then rotates back automatically driven by its internal springs to its locked position inside the fitting.

However another type of SAT, which might be called a Flat Head SAT, which has a reduced head size terminating in a largely horizontal top face which cannot be driven to rotate by pressure from the corner fitting acting vertically upon it. The corner fitting simply comes to rest upon the flat head. So unless the flat head is substantially rotated inside the fitting aperture by other means it cannot lock to the fitting. Furthermore once inside the fitting if the flat head is not substantially engaged by rotation, then when hanging from the corner fitting it can, when being lifted up in the air some 100 ft by a crane onto a ship and due to vibration or handling impacts, fall out of the aperture with the risk of injury to personnel on the ground.

The internal torsion springs of the SATs in general can be inadequate to drive the head past blemishes such as damage, dirt and corrosion that is inevitable under the heavy use of containers and their SATs, and ensure full locking inside the fittings.

So it is important to find a way to align the flat head of SATs with the elongate socket in the fitting, and then once through the socket robustly drive the head rotation to overcome the blemishes preferably until the head can rotate no more when the SAT mechanism reaches its

stops. However once rotated to the locked position, the tail is too in the locked position so it must now be permitted to rise out of the top plate without catching.

Some SATs have a head and tail rotation which is clockwise when viewed from underneath to unlock the head from a corner fitting above. Other designs operate in the opposite direction so a means to be able to work with one or other of the SATs is desirable.

Recently another type of coupler has been devised which is a solid single piece component as shown, for example, in prior documents US20150203287A1 and DE102012201797B3. This type of solid connector is known as a SmartLock or fully automatic twistlock which in this application will be referred to as a 'FAT'. It has a head and a tail joined by a collar formed as one piece. In operation the head is inserted up through the elongate socket aperture of the bottom fitting of the upper container and locked there by rotating it, and the tail is formed as a hook which can enter and connect to the socket aperture in the top fitting of the lower container or into a socket aperture of a structure such as a ships deck. However the head of these FATs is such that they need complex angular manipulation to fit and remove them from the corner fittings.

When containers are being handled on or off a ship, the time it takes at the berth is critical to the productivity of the terminal. Ships that can be turned around more rapidly can sail more slowly which means fuel saving and hence reductions in cost and pollution. Thus berth productivity is an important focus for shipping lines and terminals. To gain this environmental and commercial benefit, it is important to be able to remove or fit the SATs and FATs rapidly from and to the containers during the crane handling movement off and on ship.

Space on the quayside is at a premium and there is heavy traffic moving containers about all the time. Ease of use is important under such stressful conditions. So equipment which is versatile yet compact, is able to be handled and set up in line with the cranes with existing terminal operating machines, and be transported rapidly and easily to and from the quayside for use is a great benefit.

FATs are more complex to handle requiring, for removal, actions which to date have necessitated manipulation by hand to achieve and feel the engagement or disengagement of the coupler in its cooperating corner fitting.

Also, not all FATs are the same shape and variations in probes or projections to stop the FATs from coming out of the corner fitting by mistake and for ensuring that they are orientated correctly to minimise manual error mean that different displacements and rotations may be needed. Thus if a machine could be devised that could process more than one known FAT design would be an advantage.

Again, because the FATs are tight fitting in the corner fitting apertures a high degree of precision is needed to engage or remove the FATs from the corner fittings. If they should be only partially withdrawn from the apertures and the containers then lifted by a crane whilst still carrying a FAT then there is the risk that the FAT might drop out onto men below.

It is an object of the present invention to provide a rig which addresses the above issues and allows rapid and safe fitting and removing of FATs (and SATs) from container lower corner fittings.

Thus according to the present invention there is provided a rig for connecting or disconnecting container couplers to or from the four lower corner fittings of a shipping container, the rig comprising two pairs of corner units held in the required transverse special relationship by a structure extending between the two corner units of each pair to form two operating modules, and a base member having sockets and/or other connectors to secure the operating modules to the base member to enable the corner units of the modules to simultaneously engage all the four lower corner fittings of a container lowered onto the rig, each corner unit including an indexing means for engaging and manipulating an associated coupling to connect or disconnect the coupling to or from its associated container corner fitting.

The sockets and/or other connectors may be positioned to enable the operating modules to be secured to the base member in a plurality of longitudinally spatial relationships so that

containers of different lengths or using different types of couplers can have their lower corner unit engaged simultaneously.

Such a rig greatly speeds up connecting or disconnecting container couplers to or from the lower corner fittings of a shipping container and avoids the necessity for personal to get close to or underneath containers during such operations thus greatly improving the safety of personnel. The rig also allows handling of different lengths of container and containers with different types of coupler greatly improving its efficiency.

Other features of rigs and corner units in accordance with the present invention are set out in the accompanying sub claims of this application.

As indicated above FATs are more complex to handle requiring for removal actions which to date have necessitate the manipulation by hand to achieve and feel the engagement or disengagement of the coupler in its cooperating corner fitting. The rig of the present invention has overcome this problem by providing a corner unit which can manipulate the coupler to ensure its connection or disconnection without requiring manual intervention.

The present invention will now be described by way of example only with reference to the accompanying drawings in which

Figure 1 shows a shipping container being lowered onto a rig in accordance with the present invention;
Figure 2 shows two rigs joined together in a side by side configuration for easier handling and processing two containers simultaneously;
Figure 3A shows the container being lower onto cushioning components;
Figure 3B shows two end modules stacked and connected by a SAT;
Figure 3C shows two modules stacked without the use of a connector;
Figure 4 shows how end modules of the rig can be moved from a 20ft container position to a 45ft Container position;
Figure 5 shows rigs stacked on a trailer for transportation;

Figure 6A shows some internal details of an end module which forms part of a rig in accordance with the present invention;

Figure 6B shows a flat headed SAT entering a container lower socket aperture;

Figure 6C shows a conically headed SAT entering a container lower socket aperture;

Figure7A shows a view in the direction of arrow A of Figure 1 showing internal details of one form of corner unit suitable for use in a rig in accordance with the present invention;

Figure 7B shows a view similar to figure 7A with various component omitted for clarity;

Figure 8 shows a view in the direction of arrow B of figure 1 or figure 7B showing further internal details of the corner unit.

Figure 9 to 12 show a series of views showing various stages in the removal of a FAT in the corner unit of figures 7A to 8;

Figures 13A and 13B show how a corner unit can be adapted from processing FATs to SATs;

Figures 14A to 14E show perspective views of different stages in the operation of another form of corner unit for working on FATs in a rig in accordance with the present invention;

Figure 15 shows various configurations for rigs in accordance with the present invention, and

Figures 16A to 16D show different rig module layouts for use in the present invention.

Referring to figure 1 of the drawings this shows a crane spreader 10 lowering a container 11 towards a rig 12 in accordance with the present invention which comprises a base member 13 and one or more pairs of end modules 14 each module having two corner units 15 joined by a transversely extending structure 25. The corner units 15 are used for fitting or removing couplers 16 to or from the bottom corner fittings 17 of container 11 as will be described below.

The base member 13 of rig 12 is in the form of a rectangular frame having side members 18, end members 19 and cross members 19a. These members are provided with sockets 20 or other fixing means along the top of the frame members to allow several pairs of end modules 14, 14', 14'' to be attached to the base member at different longitudinally spaced positions to allow containers of different lengths to be handled. In the example shown end modules 14 are positioned to handle 40ft containers, modules 14' will handle 45ft containers and modules 14'' will handle 20ft containers.

The rig is also provided with end guide posts 21 and side guide posts 22. These guide posts may pivot down to allow more convenient storage of the base member of the rig or may be removable by, for example, being inserted into pockets 23 in the side members 18. These guide posts may be replaced by or augmented by guide plates 44 (see figure 7A) mounted on the corner units 15. It is envisaged that the side and end guides could be fitted to the base members as shown or if the end modules are made taller and stronger be fitted to the ends and sides of the end modules themselves.

Each end module 14 has two corner units 15 joined by a transversely extending structure 25. This structure 25 may house actuating means for the corner units 15 (which is described below). Other equipment such as boxes, battery packs, solar panels etc. can too be housed in the structure 25 or alternatively or additionally be housed in or on the base member 13. The structure 25 or base 13 may also house a proof load to enable the rig to test the strength of the corner fittings and couplers as described and claim in the Applicants co-pending application No. PCT/2019/000067. Each module may have one or two pairs of couplers which connect with pairs of the sockets 20 in the base member.

When the rig is used to connect or disconnect SATs from containers the container being lowered is supported on the top plates of the corner units. In the case of FATs the container is not supported on the top plate 310 (see figure 6) of the corner units of the end modules but on support members carried by the base member which hold the container at the required during connection /disconnection. These support members may be rigid components carried by the base member or can be resilient cushioning components 27 mounted on side members 18 some of which are shown in figures 1 and 3. These cushioning components 27 (which may be of an air spring construction) reduce the impact of a heavy container 11 landing on the corners units 15 of modules 14 when SATs are being handled or, in the case of the FATs, where the corner posts do not support the container, the cushioning components 27 support the weight of the container above the FAT corner unit to allow the FAT corner unit to perform its operation. Preferably the support members act upwards onto the floor bearers 75 of base structure 11a of the container which as defined by ISO 1496 standards are positioned and intended to be able support the container if required.

Figure 3A shows part of a 40ft container 11 being lowered onto rig 12 for the connection to the container of SATs 28 supported in corner units 15 of the end modules 14 and the cushioning components 27 reducing the impact of heavy container 11 landing on the corners units of modules 14.

If this operation were to be carried out on a 45ft container the end guide posts 21 for the end module positioned at the 40ft position would be folded down as shown in dotted detail 21' in figure 4 which also shows the crane spreader 10 set at 20ft picking up two end modules 14'' from the rig as indicated by arrow X.

In figure 3B and 3C the end modules have flip up corner adaptors 29 which can be pivoted (see arrow Y) about pivot pin 304 from an inactive position 29' to an active position over the top of top plate 310 at each corner unit to provide a standard socket for the spreader twistlocks to connect to the end modules and lift as denoted by arrow W. Two end modules can be seen in figure 3C showing how with the adaptors 29' still folded the modules can also be stacked. If the modules are to be connected together then the adaptors 29 are raised and SATs 16 can be fitted between the sockets 31 in the bottom plates 306 of the modules and the adaptors 29.

It is envisaged that the adaptors 29 need not be pivoted but could be loose or chained items lifted or moved into place on the top plate 310 and incorporate a connector such as a rotating tail 104 or similar to be locked to the top plate.

Ideally the weight of the modules is balanced centrally under the raised flip up corner adaptors 29 so that the modules hangs squarely below the spreader 10 with their centres of gravity passing through or close to a horizontal centre line joining the lifting centre denoted line 303 of the two corner units of each module. The lifting forces pass through the adaptor 29, through the pivot pin 304 and thence to the end module 14. If the end modules 14 are attached to the base 13, then that too is lifted.

In figure 4, if the crane driver wishes to place the end modules at the 45ft location on the rig for use with 45ft containers, he instructs the spreader 10 to move to the 45ft position seen in dotted line 10'. The 40ft guides 21 have been folded down out of the way to their stowed

positions 21' and the end modules at the 40ft position disconnected and removed from the base 13. The modules 14'' are lifted and then now lowered as indicated by arrow Z and locked through additional sockets 20 and associated connectors to the base member 13 and the flip up corner adaptors 29 are folded down out of the way. It is envisaged that the side members 18 or additional longitudinal rails could be fitted with known retractable roller conveyors so that should a module be required to be moved from say the 40ft position to the 45ft position, it can be raised up by the roller conveyor acting on the underside of the module sufficient for the connectors between module and base member to clear and then be conveyed longitudinally until it reaches the 45ft position there to be lowered onto connectors and locked to the base member.

Figure 2 shows two rigs 12 located next to each other seated on top of two transverse adaptor beams 30 one at each end. Note that one container being handled on one base member is a common use of the rig but this example shows the modularity of the rig and how two such rigs can be operated simultaneously. The adaptor beams 30 lock to sockets 20 also provided along the underside of the base members 13 of the two rigs. The adaptor beams keep the rigs orientated in the correct position so that the two 40ft long containers 11 can be lowered towards the base members simultaneously. The base members have end guide posts 21 and side guide posts 22 as referred to above. The end guide posts 21 are hinged by large diameter tubes through the base member 13 (or could be similarly hinged on the end modules 14) and can be locked in the erect position or folded down when not in use. The side guide posts 22 slide within pockets 23 in the base (or as envisaged in the sides of the modules 14) to allow adjustment for different width containers to fit between them. They can be fitted to both sides of each base member or as shown in figure 2 on one side only. All guides can be removed for compact shipping. The containers show couplers 16 in their bottom fittings for removal (or fitting in the converse). The guide posts guide the containers so as to align the couplers with the corner units for removal.

The two rig arrangement shown in figure 2 can be lifted side by side especially when connected together with the adaptor beams 30 and using, for example, a container lifting beam arrangement as described and claim in the Applicant's application No. PCT/GB2018/000021. As the adaptor beams 30 having sockets in their undersides they can

then be locked with the two side by side rigs to a trailer or waggon for transport as a single unit. Indeed, a lifting beam can remain locked to the two Rigs and be transported at the same time along the quayside for use with another crane or location.

Figure 5 shows how rigs 12 can be stacked with the end modules 14 still attached. The end modules 14 can have their flip up corner adaptors 29 raised for connecting the stacked rigs together and to transmit stacking forces through to ground. The stacked rigs can be transported on, for example, a trailer as shown with the guide posts 21, 22 and projecting components such as cushions 27 removed, folded, deflated etc. to enable the stacked rigs to be shipped, stored, transported on existing container infrastructure.

It is envisaged that modules, not necessarily those with end modules, can be devised for use with the rig such as battery packs, solar panels, generators, connector storage boxes, detection devices, for coupling with the base member sockets 20 or other fastenings and conforming to the need to seat low enough to not foul the underside of containers or rigs stacked over them on end modules or cushioning components 27.

Figure 6A shows details to one side of a typical end module 14 with a SAT 103 shown with its head 106 and tail 104 both in the locked position illustrating how it would look if it had just been connected to and lifted by fitting 17' shown in dotted lines. The four sockets 31 (only one shown) in the bottom plate 306 allow connection of the end module to the base member 13 or to another end module when stacking for storage. The flip over corner adaptor 29 is shown in its stowed position 29'. Each corner unit has its own internal mechanisms (examples of which are given below) for manipulating couplers such as SATs 103, 310 and FATs 42, 90 in order to connect or disconnect such couplers to and from shipping containers lowered onto the rig. Batteries 32 are shown in this example and provide the power to an actuating means in the form of, for example, a linear electric actuator 33 which in this example drives a mechanism in the form of a lever 307 in either direction, pivoted about pin 308, through a resilient component 36 to a pin 309. As the actuator retracts the lever rotates from position 307' in dotted line to 307.

The free end of the lever is connected to a driving means comprising here a chain 35 so that as the lever is displaced it drives the chain in the direction of arrows V causing the sprocket 311 to rotate and with it the indexer 34. In operation when the tail 104 of coupler 103 is inserted through socket 313 in top plate 310 and engages with indexer 34, the rotation of the indexer causes the tail 104 and significantly the head 106 to rotate inside the fitting 17 so that it cannot fall out. The tail 104 having rotated is now in the corresponding locked position so that for its projecting elements 314 clear the socket 313. The socket is enlarged at 313' in this example, in the clockwise direction of rotation of the tail to facilitate elements 314 clearing the socket 313.

Figure 6A also shows an operating toggle wire 350 of the SAT 103, which, in the known manner is used to move moves the SAT between its various rotational positions. This wire is supported on a guide 351 on the top of the corner unit. The guide 351 holds the toggle wire 350 clear of the known toggle wire catches 352 and 353 positioned above, below and to the side of the toggle wire to ensure that the efficient operation of the SAT during use of the rig. A clip or magnetic catch or inclined side guides 82 can be used additionally to guide the wire on guide 351 if required.

The chain 35 is connected to the righthand corner unit 15 of the end module 14 as illustrated and to the left hand corner unit (out of view) activating a sprocket and indexer and SAT as described simultaneously. Coordinating the two corner units has the benefit of preventing rotation of both tails 104 in the event that one tail is not fully inserted in the indexer.

The resilient component 36, should the FATs or SATs being handled by the indexers 34 encounter any obstruction during their connection or disconnection, allows the indexers to continue to urge the displacement of the FATs or SATs without any damage occurring to the drive mechanism or the actuator. The component 36 comprises a box containing a sliding block 315 connected to the drive rod 316 of the actuator 33 that slides fore and aft against pre-loaded compression springs 317. The box 36 is connected with lever 307 via a rod 316a which is connected with pin 39. The springs 317 keeping the block 315 centrally within the box 36 unless the actuation of the actuator 33 reaches an obstruction when a one spring compresses more and the other less. One benefit of this action is that should the obstruction

be the landing of the head 106 against the SAT's own stop 107 then the springs maintain torque on the head. If a SAT of another design should have a stop at a different rotational position say 35 degrees instead of 60 degrees, then the actuator can still extend the same stroke for both and the springs 317 absorb the difference generated and the torque essential to lock the head in the corner fitting be maintained.

In figure 6B there is seen an example of a flat headed SAT 103 with flat topped head 106 being offered up to the socket 54 in the bottom of the corner fitting. The lines 108 indicate the width of the socket and it can be seen that the socket is too narrow for the head 106 to enter resulting in the bottom face of the fitting abutting the flat topped head 106. However, in figure 6C where another type of SAT 110 is being offered up, the known conical head 111 easily enters the socket 54 and as it progresses into the socket, the head 111 is rotated as known until it enters the socket. Thus for a flat top SAT it is necessary for the corner unit to rotate the head 106 to align with elongate profile of the socket 54 and allow them to mate. Returning to figure 6A if the SAT 103 shown is lowered into the corner unit 15, the linear actuator 33 is then activated to drive the lever 307' to position 307 thus rotating the head 106 into alignment with a socket 54 so that a container with fitting 17' can be lowered fully over the head. The actuator is then activated to drive in the opposite direction and the head 106 is rotated to lock inside the fitting 17'.

When SATs 103 and 110 are being lowered hanging from the container positioned as couplers 16 in figure 1, they are typically set with the tail 104 aligned with the elongate sockets similar to socket 54 as seen in figure 600A. From this halfway rotated position of the tail, to remove rotate the head 106 to release it from the fitting 17, it is only necessary to rotate the tail (and thus head) by a lesser angle than when fitting a SAT. So, looking at figure 6 the actuator can be re-positioned for SAT removal by driving the actuator and thus the lever to a midpoint between position 307 and 307'. At the mid-position the tail inserts straight into the indexer 34 and once there the actuator is activated to pull the lever to position 307 and with it rotate the indexer and the tail of the SAT and thus unlock the head 106 from the fitting 17 enabling the socket 54 of the fitting to rise clear disengaged with the head.

It is envisaged that the actuator is powered by one of a number of known power sources such as batteries, mains power, hydraulics, pneumatics or energised springs retained by triggered catches. The rotation of the sprocket 311 is less than 140 degrees and therefore the sprocket could be replaced by levers similar to lever 307 and its pivot 308 be sited on a transverse line joining axis P of the corner unit the levers being pinned to each other by a driving means comprising a transverse rod pushed and pulled by the actuator 64 so that the levers act in unison.

One example of a corner unit 15 suitable for handling FATs in an end module 14 of a rig in accordance with the present invention is shown in figures 7A to 12. Figure 7A shows a bottom corner of the container 11 viewed from the side in the direction of arrow A of figure 1. The corner unit 15 has two side plates 53 and 52 each with cam slots 50 and 51 formed through the plates through which project cam followers formed as pins 49 cantilevered from box 47. In this example the corner unit 15 is mounted via a base 40 of the end module 14 through which are formed sockets 31 for the attachment using connectors to the sockets 20 in base member 13. Compression springs 41 pinned to the base 40 hold the corner unit in a substantially vertical position but enable it to be displaced (sideways, lengthways and vertically) by the action of a FAT 42 finding its way into a socket 43 of the corner unit or as the container corner fitting 17 (partly cut away to reveal workings) encounters guide plates 44 as the container is lowered. A vibrator 112 comprising an electric motor with offset load is mounted on the corner unit which when vibrating induces medium frequency impacts between the moving surfaces of the FAT 42 and the fitting 17 thus enabling the indexer to displace the FAT more easily and overcome snags, friction, dirt and small distortions in the surfaces of the fitting 17. Only one of the guide plates 44 is shown in figure 7, the guide plate at right angles to that shown has been removed in this figure for clarity. An actuating means in the form of a linear actuator 64 is mounted pivotally between the structure of the end module 14 and the front of the box 47.

In figure 7B and other figures 9 to 12 the same corner unit is show with the nearest side plate 52 having been cut away to show its peripheral outline and the outline of the two cam slots 50, 51. The box 47 has pins 49 seen on the near side but which are replicated on the other side through plate 53.

Figure 8 a closeup in the direction of arrow B of figure 1 of the bottom corner fitting 17 with the guide plates 44 completely removed.

Socket 43 is provided in an indexer in the form of a cylindrical driver 45 mounted in a circular bearing 46 formed in a box 47. A drive shaft 48 is attached to driver 45 and extends down through a bearing in the floor of the box 47. The box 47, driver 45 and shaft 48 share a central vertical axis A. The driver 45 and shaft 48 can rotate within the box 47 guided by the bearing in the floor of box 47.

Containers comprise large fabrications which require moderate manufacturing dimensional tolerances and those from handling damage. Thus the overall width and length defined by the positions of the corner fittings 17 can vary around +/- 5mm one container to another. The dimensions of the corner fittings 17 are more closely toleranced being within +/- 1mm so that the socket aperture 54 in the bottom of typical corner fittings 17 which hold the FAT 42 is located accurately relative to the bottom surface 17b, side face 17a and end face 17c of fitting 17.

Whereas side and end guides 22, 21 are present as described earlier to guide the container 11 into reasonably accurate place over the corner units, the hook 55 of FAT 42 remains aligned accurately with socket 43 as it is lowered due to the guide plates 44 closing in and pressing on faces 17a and 17c of the fittings under the action of springs 41. Figure 10 shows indicates the guide plates 44 can be deflected at 44' during lowering of the container deflecting with them the corner unit 15 with its box, driver, and if located in the socket 43 a FAT 42 all supported yet allowed to defect on the springs 41. To accommodate the defection, the actuator 64 can be mounted on resilient bearings or mountings or be mounted on an extension of the corner unit to travel with it. Alternatively, the drive shaft can be fitted with a resilient component 36 as illustrated before.

For reference displacement sideways of the whole container with its FATs is required by the workings of FATs as seen in patents US20150203287A1 and DE102012201797B3 and others.

Such displacement complicates the location of the FATs 42 with the sockets 43. To avoid this displacement the axis B of the socket 43 is preferably offset from the axis A of the driver 45.

The hook 55 is seen projecting down from the fitting 17 as the container 11 is lowered towards the corner unit. The overall width of the FAT from the righthand tip of the hook 55 to the left hand side of the lower core 56 of the FAT 42 is denoted by dotted lines 57 in figure 8. The vertical centre line C of the core 56 is offset from axis A.

For the core 56 and hook 55 to enter vertically into the socket 43, the axis B and axis C are preferably closely aligned. The mounting springs 41 allow movement at least transversely of the corner unit so that even if the container is offset more than the ideal, the axes B and C can still closely align.

The head 57 of the FAT 42 with its vertical central axis D can be seen in the locked position inside the corner fitting 17 in figure 8. The FAT 42 is shaped to the left with a large under chamfer 58 as described in the prior art and this is accommodated by recess 59 in the opening of socket 43 so that when the FAT enters the socket 43 it can be driven about axis A yet can be lifted up or down vertically there being no additional support plate on the top of the corner unit 15 in this configuration through which the FAT must pass and which might therefore inhibit it.

In figure 8 there is seen the shaft 48 which passes through a bearing in the bottom of the box 47 and engages with, for example, an actuating means preferably in the form of an electric stepper motor 66 mounted under the box connected to the shaft 48 which given pre-determined electronic signals will rotate the shaft by a designed amount of for example 65 degrees depending on the design of the FAT. This rotation is that needed to align the head 57 of the FAT with the socket aperture 54 to enable it to move inward or outward of the socket aperture 54. Known rotation of the FAT is ultimately restricted by the collar 63 (figure 9) of the FAT abutting the vertical side faces of the socket 54. It is envisaged that the motor be mounted on flexible mountings and/or the connection or drive to the shaft be of a flexible connection such via as a torsion spring to absorb variations in rotational position of one FAT design or manufacturer to another.

In figure 9 there is seen an enlarged side elevation of a container 11 with FAT 42 being lowered towards the corner unit 15 guided by guide plates 44 (side guides here removed for clarity). Side plate 52 is removed as before to show the interior workings of the corner unit. The corner unit 15 is supported in a raised position by the springs 41 so that the top surface 60 of the driver 45 is preferably level with the top surface 61 of a container support 62 (as is indicated by dotted line 65) during operation of the corner units. The fitting 17 is shown in section to reveal the elongate socket aperture 54. Within the socket aperture 54 is the collar 63 of the fitting FAT 42 which joins the head 57 to the hook 55 and is able to rotate within the width of the socket aperture 54 as known in the prior art. Actuating means 64 is seen pinned at 67 to arm 65 fixed to the box 47 and pinned by pin 69 at the other end to support 62 the pins allowing articulation in a vertical plane. Thus motor 66 rotates the FAT 42 within box 47 and actuating means 64 moves the box 47 in a vertical plane.

In figure 10, a side elevation as figure 9, container 11 has landed so that its base structure 11a, 75 is supported by the top 61 of support 62. It is a standard feature of shipping containers such as container 11 that the bottom face 17b of the fittings 17 project down below the bottom of the chassis 11a by typically 12 to 17mm. Thus the corner unit 15 with its supporting springs 41 is pushed downwards as illustrated by the new position of dotted line 65' now below the top 61 of the support 62 compressing the springs 41 designed to accommodate vertical displacement 0mm to 25mm, or more, yet providing an upwards force to raise the head 57 inside the fitting 17 to clear undulations, roughness and shoulder keys 28 provided on some FATs (see gap 87) allowing the head freedom to rotate inside the fitting.

Alternative support of the container base structure 75, 11a was described earlier whereby supports 27 could be used.

With the FAT engaged with the socket 43 the axis A of the driver 45, socket 43 and shaft 48 are colinear with the central vertical axis D of the head 57 and axis E of the bottom socket aperture 54 of the corner fitting 17. So as the shaft 48 is rotated, in this example counter clockwise when viewed from underneath denoted by arrow F, the FAT is rotated until its head 57 reaches an elongate orientation approximating to the elongate corner fitting aperture 54

where it can be removed from the aperture. The hook 55, core 56, and axis B (see figure 8) are swept radially about the axis A, not concentrically. The side plates 52 and 53 of the corner unit 15 are not shown in figure 10 but the cam slots 50, 51 and the pins 49 are indicated.

Once the FAT 42 is sited in the socket 43, the motor 66 is triggered mechanically or electronically to rotate the shaft 48, driver 45 and the FAT 42 to align its head 57 with the aperture 54.

If the head 57 of the FAT aligns reasonably with the aperture 54 the container 11 could be lifted up vertically leaving the FAT 42 behind as described later around figure 14. However the FATs typically have horizontal probes or noses 68 and 81 which extend the heads 57 inside the fittings 17 and can overlap the apertures 54 so that when lying close to the apertures 54 further displacement action of the corner units 15 to free the FATs from the fittings 17 is necessary.

Within the fitting the steel surfaces can be rough and damaged so raising of the head within the fitting is advantageous to help clear these obstructions. So during operation it is necessary to move the FAT vertically upwards and horizontally to a free central position, seen in figure 10, so the head 57 with its noses 68 and 81 and the collar 63 clear the geometry of the interior of the fitting including the aperture 54 to a position where only rubbing slidable contact is made with the interior throughout its rotation when activated. Where a shoulder key 28 is provided the upwards lift must be sufficient to clear this key from the socket aperture 54.

In figure 11 the box 47 with driver 45 and FAT 42 have been tilted counter clockwise in this view by the action of the actuator 64 driving the box 47 with its pins 49 along the slots 50, 51. The head 57 of the FAT is seen passing out through the aperture 54. The actuating means 64 can be of any suitable type such as an electric linear actuator, a hydraulic or pneumatic ram, or springs or a combination of actuator for displacement and, for example, a tension spring to counterbalance the weight of the box, driver, FAT and shaft. The actuator is mounted to provide a horizontal and vertical components of force to match the reactive requirements of the pins 49 as they slide along slots 50, 51 without jamming. The shape and location of the

slots is determined by the matching of the geometry of each design of FAT to that of the fitting 17 so as to guide the FAT along a locus which ensures its release or fitting from or to fitting 17.

So, for example, when operating on one type of known FAT, the head 57 is moved relative to the container, then the head 57 is rotated to align with the socket aperture 54 which typically is when sides of the collar 63 abut sides of socket 54, then a counter clockwise tilt simultaneously sliding back the FAT away from the container, to clear nose 81 from the container end of the socket aperture 54, then further tilting and simultaneous lowering down from the fitting 17 until it and nose 68 are free from jamming within the fitting.

To avoid the potential of jamming of FATs within the fitting 17, a vibrator 112 seen in figure 7B may be provided which can be energised to cause the FAT to free itself from small snags and shapes often found within cast steel and fittings of the type used in the fittings 17 and FATs 42.

The coordinated movements of the motor 66 and actuator 64 which carry out the above movements of the coupling are achieved with a programmable computerised controller further enhanced by sensors to verify any errors encountered during the movement due to snagging and the like, backed up by the action of vibrator 112. The controller programme defines the displacements, speed of deployment, and force at different times and phases of the operation.

Fitting FATs 42 to containers 11 with fittings 17 is achieved by reversing the procedure described above for removing a FAT. A FAT is placed in the socket 43 and a container 11 is then lowered onto the supports 62 being guided by guides 9. Actuating means 64 is then triggered to tilt the FAT upwards and into the fitting 17 via aperture 54 and to then rotate the FAT with its head 57 within the fitting 17.

The actuating means 64 may be programmed and/or electronically controlled to govern their stroke, force and speed according to the geometric size and shapes of differing FATs.

The springs 41 might be assisted by actuators to adjust their forces and direction of their forces or completely replaced by actuators.

It is envisaged that the socket 43 be shaped according to the shape of the FAT or SAT and thus the driver 45 is removable from the box 47 so that the driver can be changed to allow different couplers to be handled by the same corner unit. Alternatively, the driver and box may be combined and this combined box/driver component is then changed to handle different couplers.

Figure 13A shows a FAT 42 in the socket 43 of a driver 45 with the axis E of fitting aperture 54 aligned with the axis D of the head 57 and the collar of the FAT so that the FAT can be rotated and unlocked from the aperture 54 and then removed as described earlier.

Figure 13B shows how an adaptor 100 which consists of a plate 101 with an aperture 102 similar to socket aperture 54 can be positioned on top of the corner unit so that if a SAT 103 is offered up to the corner unit 15 rotation of the tail 104 of the SAT can be carried out by the same corner unit mechanism as used for FATs. As shown in Figures 13A and 13B the adaptor plate 101 can be pivotally mounted at 105 on the corner unit for swinging movement between an inactive position shown in Figure 13A and an active position shown in Figure 13B.

A further example of a corner unit 15 suitable for handling FATs in an end module 14 of a rig in accordance with the present invention is shown in figures 14A to14E. Figure 14A shows container 11 with its corner fitting 17 with its socket aperture 54 being lowered towards the head 91 of a FAT 90. The FAT 90 has tail 94 inserted into socket 164 of indexer 144. The socket 164 is of elongate shape similar to aperture 54 in fitting 17 described above so that hook end 95 of FAT 90 engages inside the socket 164 and the intermediate plate 103 of FAT 90 is supported close to indexer 144. A leaf spring 165 mounted within bracket 171 is set there to urge the tail 94 of the FAT upwards and unimpededly support it so that the intermediate plate 103 is above the indexer 144 by some 4 to 10mm. This spring 165 helps the FAT 90 to free itself from the aperture 54 and in the case of the FAT claimed in DE102012201797 it is necessary to raise the FAT 90 up to clear its aperture plugging shape before it is able to be rotated. It is envisaged that other springs or biased guides can be provided to support and

offer up the FAT 90 to the aperture 54 yet allow deflection as insertion forces between fitting 17 and indexer 144 come naturally into play.

The position of the indexer 144 with socket 164 is such that head 91 of the FAT 90 is aligned with the socket aperture 54 in the fitting 17 so that as the container 10 is lowered the head enters the aperture 54. There is provided a torsion spring 158 wrapped around the shaft 130 and which in this position biases the bracket 171 with indexer and handle 123 to rotate counter clockwise, prevented in doing so by the handle 123 bearing on catch 84 being part of catch assembly 73 mounted and operated as described earlier. The spring 158 is fixed to the bracket 171 at one end and a gear box comprising gear 163 and 162 driven by handle 161 fixed by conventional means not shown here to the structure 70 of corner unit 15 at the other.

In figure 14B there is seen the base 160 of container 11 coming to rest on the top 159 of structural member 70 and the fitting 15 making relatively light contact with the intermediate plate 103 of FAT 90 contact being maintained by a spring 165. Top 86 of plunger 72 is at this point in the sequence pressed downwards by the base 160 of the container which causes it to press down on catch assembly 73 to position 73' thus lowering the catch 84 and releasing the handle 123 in turn allowing the shaft 130, bracket 171, indexer 144 and FAT 90 to rotate typically about 70 degrees counter clockwise thereby locking the head 91 of FAT90 inside fitting 17.

In figure 14C the container 11 is seen lifted away from the corner unit 15 taking with it the FAT 90 and allowing the plunger 72 to rise up and likewise catch assembly 73. The hook 95 of FAT 90 slides out of the socket 164 by known means entailing a horizontal transverse displacement of the hook 95 as it rises out of the socket.

In figure 14D the back 157 of the FAT 90 is seen opposite the hook 95. In this figure the container 11 has engaged in its fitting 17 the FAT 90 and is seen being lowered towards the corner unit 15. The socket 164 is seen aligned with the tail 94 of the FAT and the socket 54 of the fitting 17. A block 155 with stop 156 is fixed to the structure 70 below the rotating indexer 144. The handle 123 abuts the catch 84 and in this position is being urged to rotate clockwise by spring 158. Spring 158 has had its bias reversed by dint of gear 163 being driven in reverse by gear 162 with handle 161 moving from position 161' to position 161'' (see figure 14E). The

gear ratio of gear 162 to gear 163 is devised to be preferably 4:1 so that from a ¼ turn of the handle 161 in either direction from a neutral position between 161' and 161'' a rotational deflection of the torsion spring 158 of 360 degrees can be achieved.

As the base 160 makes contact with top 159 the tail 94 enters the socket 164 and plunger 72 is driven down to move catch assembly 73 to position 73' thus lowering the catch 84 allowing the handle 123, shaft 130 and indexer 144 to rotate clockwise rotating the FAT 90 clockwise and aligning its head 91 with the socket aperture 54 in the fitting 17. The back 157 of the FAT is driven around to make contact with or come close to stop 156. Container 11 can now be lifted away from the corner unit without the FAT 90. Friction and jamming of the FAT in the aperture 54 might tend to lift the FAT 90 up with the container 11 so to hold the FAT down within the corner unit 15, hook 95 is held within the socket 164 by the location of stop 156 sufficient to prevent the hook sliding out from within the socket yet enabling the FAT 90 to tilt and move to free itself from contact with aperture 54 urged on by the direction and support of spring 165.

In Figure 15 an alternative form of rig, shown diagrammatically 246, has corner posts 206 fixed at each corner. Alternatively, corner units 206 can be attached in pairs to frame 270 to form modules as described above and frame 270 may include a box 270a in which weight is placed for proof testing. If proof testing is not required such boxes can be used to store FATs or SATs. The modules 206,270,270a can be located on a terminal trailer 245 and secured to it by SATs or FATs which can be spaced apart along the lengths of the trailer to suit different container lengths such as 20fts, 40ft, 45fts. More than one type of corner unit can be put on one trailer 245 or frame 246 so that, for example, modules with corner units 206 set at a 40ft spacing for processing SATs can be offset from modules with corner units 206' for processing FATs. If operating modules with corner units 206 and connecting frames 270 with reach stackers 247 or forklift trucks requiring access to the side of a container, the modules 206, 270,270a can be placed or secured on the ground with access space for the reach stacker made between them. Several frames 70, 70' could be located side by side for faster processing large numbers of containers and fitted as required with different models of corner units 206 should different types of SATS or FATs need to be processed without involving conversion of the mechanisms within them. When the frames 270 are mounted on a trailer 245 they could be conveniently moved to the quayside or other location or adjusted in location should

processing of the container so require it. Alternatively, a container 11 can be locked to the corner posts 206 with the SATs or FATs and lifted together with any frames 246 to which they are attached with the spreader of a transport machine such as straddle carrier 240 and rapidly moved to another location. As indicated above, where more than one model of corner unit 206 and say 206' is required to enable processing of different types of SATs or FATs, then more than one pair of modules with different corner units 206, 206' can be added to a frame such as 246 so that a container of a given length can be processed either to one end of the frame or to the other depending on its type of SAT or FAT being handled.

It is envisaged that a rig 246 might be fitted to a trailer or indeed be fitted with wheels to become a trailer in its own right such that a container being lowered onto it can be locked to that trailer using the means described herein to safely transport it without toppling off.

In Figures 16A, 16B, 16C, 16D there are seen in plan view some examples of the versatility of the rigs and end modules of the present invention. In figure 16D a pair of corner units 206 can be seen in the bottom right hand corner of the figure. A module 133 is seen at the bottom, adjacent to it module 133' displaced say 5ft from it longitudinally, and a third module 133" some 45ft away from it so that these 3 modules can be used for containers of length 40ft, and 45ft long without further length adjustment.

Other modules 133 shown in Figures 16A and 16B and 16C can have different corner posts 206, 6', 6", 6''' fitted to accommodate different couplers. For example, units 206 might be for common SATs and units 6' might be configured for FATs and units 6" and 6''' for yet other types of coupler. In Figure 16A the four types of corner unit 206, 6', 6", 6''' are set out for use with a 20ft container.

In Figures 16B and 16C two rigs 12, 12' comprising modules joined to receive 20ft long containers are set end to end. 20ft containers are sometimes joined together with longitudinal locks called mid-locks and to fit and remove these the containers might need to be displaced apart longitudinally. The figure 16C illustrates how a hydraulic ram 141 or other mover could be used to displace or bring together the two rigs 12, 12' to fit or remove mid-locks.

It is also envisaged that a rig in accordance with the present invention may include more than one pair of corner units at each end of the rig, different pairs of corner units being used for different types of coupler or for carrying out different operations on couplers placed in the corner units. For example, each end of the rig might have three pairs of corner units one pair to attach couplers to containers, one pair to detach couplers from containers and the third pair to lock the container to the rig for proof load testing. These couplers can be close together, and even combined into a single three aperture unit. The upper part of Figure 16C shows diagrammatically units 206A for testing, units 206B for auto fitting and units 206C for auto removal of SATs. Where side guides 22 are required to help locate the containers, these can be designed for adjustable transverse positioning to guide the containers to which corner units are being utilised.

It is an important feature of the present invention that the rig provided is quick in operation as the various corner units operate immediately the container is lowered onto the rig with the operation of the corner units being triggered mechanically or electronically by lowering of the container onto the rig. Thus an operator can place in the rig or remove from the rig couplers whilst the handling machine is picking up its next container giving a more or less continuous process.

A further important feature of the present invention is that the rig provided can be transported to its port of use in sections for assembly at the port.

Although the invention has been described above in relation to rigs used on the dock side or on a trailer it will be understood that the rigs could be connected to any suitable structure such as a ship's deck or a container or on structure connected to cranes or lifting machinery to remove couplers from containers wherever wanted.

CLAIMS

1. A rig for connecting or disconnecting container couplers to or from the four lower corner fittings of a shipping container, the rig comprising two pairs of corner units held in the required transverse special relationship by a structure extending between the two corner units of each pair to form two operating modules, and a base member having sockets and/or other connectors to secure the operating modules to the base member to enable the corner units of the modules to simultaneously engage all the four lower corner fittings of a container lowered onto the rig, each corner unit including an indexing means for engaging and manipulating an associated coupling to connect or disconnect the coupling to or from its associated container corner fitting.
2. A rig according to claim 1 in which the sockets and/or other connectors are positioned to enable the operating modules to be secured to the base member in a plurality of longitudinally spatial relationships so that containers of different lengths or using different types of couplers can have their lower corner unit engaged simultaneously.
3. A rig according to claim 1 or 2 in which the base member or modules support guide plates or posts which guide any container being lowered onto the rig so that its corner fittings register with the appropriate corner units.
4. A rig according to claim 3 having guide posts which can fold down to allow long containers or a number of rigs or bases to be vertically stacked on the rig without fouling the folded guide posts.
5. A rig according to claim 3 or 4 in which guide posts mounted on longitudinally extending sides or transverse ends of the base member are mounted in pockets in the sides to allow the guide posts to be adjusted to cater for containers of different widths or transverse positioning or lengths and to allow removal of the guide posts for storage, stacking or free side access if required.
6. A rig according to any one of claims 1 to 5 in which cushioning components are provided on the base member to support any container lowered onto the rig and reduce the impact of the container on the rig.
7. A rig according to any one of claims 1 to 6 in which corner units are provided with a moveable corner unit adaptor which can be moved from a lower inactive position

to an active position over the top of the respective corner unit to allow stacking and top lifting of the rig using standard couplers and spreaders acting on the corner adaptors.

8. A rig according to any one of claims 1 to 7 in which several pairs of modules are secured to the base member at different longitudinal spacings to allow containers of different length or using different couplers to be handled by the rig.
9. A rig according to claim 8 in which modules intermediate the modules used to locate the ends of the container being processed lie flush or lower than the end modules so as not to foul the underside of the container.
10. A rig according to any one of claims 1 to 9 in which the centre of gravity of each module lies on or close to a horizontal centre line joining the two corner units of the module when arranged for lifting by adaptors.
11. A rig according to any one of claims 1 to 10 in which the modules have two pairs of connectors connecting each module to the base member.
12. A rig according to any one of claims 1 to 11 in which the modules can house a power source and/or drive mechanism for the indexing means of the corner units.
13. A rig according to any one of claims 1 to 12 in which the base member is longitudinally telescopic to accommodate containers of different lengths.
14. A rig according to any one of claims 1 to 13 which has a base including retractable conveyors to raise, support and transport a module to a different longitudinal location.
15. A rig according to any one of claims 1 to 14 with guides and modules that can be positioned to enable the rig alone or in connected stacks to be handled and/or transported by known container handling machines and transporters.
16. A rig according to any one of claims 1 to 15 in which the structure extending between the corner units of a respective module supports actuating means for operating the indexing means in both corner units of the module simultaneously.
17. A rig according to claim 16 in which the actuating means supported on the structure extending between the corner units is connected with the two indexing units by a drive mechanism which allows easy adjustment of the extent of movement of the indexing means.

18. A corner unit according to any of claims 1 to 17 in which drive to the indexing means includes a vibrating function which acts on the coupling to overcome friction and obstructions encountered between the coupling and the corner fitting.
19. A rig according to any one of claims 1 to 17 in which the underside of the base member also has sockets and/or other connectors to enable base members to be secured to suitable structures and/or trailers or together when vertically stacked.
20. A pair of rigs according to claim 19 connected together in side by side configuration by transversely extending beams which extend under the base members of the rigs and are secured to the sockets and/or other connectors on the underside of the base members for use on the ground, or on trailers or enable lifting of the pair together.
21. A rig according to any one of claims 1 to 20 which includes a pair of modules having corner units each comprising an indexing means having a socket for receiving and holding the FAT in a defined position, a first actuating means for rotating the indexing means with the FAT about a vertical axis to engage or disengage a head of the FAT within the associated container corner fitting, and second actuating means for driving the indexing means with the FAT through a predetermined locus in a vertical plane to insert or with draw the FAT from the socket aperture in the associated corner fitting.

22. A rig according to claim 21 in which the actuating means drives the FAT along a path involving at least two of the following movements namely lifting, twisting about a vertical axis, lowering, sliding longitudinally, rotating about a horizontal axis, moving about the predetermined locus, the container being supported on its base by the rig so that the underside face, side face and end face of its bottom corner fittings remain at least partially accessible by the corner unit.
23. A rig according to claims 21 and 22 in which the indexing means includes a socket with an aperture which receives the FAT, the indexing means being supported within a box for rotation relative to the box by the first actuating means, the box being supported within the corner unit by interengaging cams and cam followers so that the box and indexer can be driven along the predetermined locus by the second actuating means.

24. A rig according to claim 23 in which the aperture of the socket is substantially rectangular and is formed or can be deflected so it is offset transversely from the bottom aperture of the associated container corner fitting so that a hook end of the FAT can be withdrawn or inserted into the aperture of the socket to allow the vertical lowering or raising of the container to be carried out without sideways displacement of the container relative to the end module.
25. A rig according to any one of claims 21 to 24 which during fitting or removing of a FAT the FAT is driven upwards to increase the clearance between the head of the FAT and the inside faces of the container fitting to facilitate rotation of the head within the fitting.
26. A rig according to any one of claims 21 to 25 in which the rotation about the vertical axis comes to a stop when the neck of the FAT abuts one or both of the side faces of the lower corner fitting socket aperture.
27. A rig according to any of claim 21 to 26 in which the actuating means comprises linear screws, hydraulic or pneumatic rams, or known springs, which can be energised and cocked ready for release.
28. A rig according to any of claims 21 to 27 in which the actuating means is programable to set one or more displacements, speed of deployment, and force at different times and phases of the operation.
29. A rig according to any of claims 21 to 28 in which the actuating means are activated by the arrival at or departure from the corner unit of a container.
30. A rig according to any of claims 21 to 29 which operates for fitting (or in reverse for removal) of a FAT using at least the following steps of, moving the head of the FAT relative to the container to free the head and any noses and/or keys for rotation within the fitting, rotating the head to align with the socket aperture in the corner fitting, counter clockwise tilting and simultaneously sliding the FAT relative to the container, and tilting and simultaneous lowering down through a predetermined locus in a vertical plane to withdraw the head from the corner fitting.
31. A rig according to any one of claims 21 to 30 in which indexing means with alternatively shaped sockets can be fitted to enable the unit to handle different types of FAT.

32. A rig according to any of claims 21 to 31 in which an adaptor can be placed above the indexing means to engage with a known semi-automatic twistlock (SAT) and operate it for fitting and removal of the SAT using the same indexing means and re-programmed actuating means.

33. A rig according to any one of claim 1 to 20 which includes a pair of modules having corner units each comprising an indexing means arranged to receive a FAT placed into the unit and in which bias means biases a lever against a stop to hold the head of the FAT in a head unlocked position, as a container is lowered onto the corner unit a plunger moves the stop to allow the bias means to rotate the indexing means to rotate and lock the head of the FAT to the lowered container and to allow the container to be lifted with the coupler.

34. A rig as claim 33 in which the bias means can be reversed so that when a container with a FAT is lowered onto the unit, the indexing means receives the tail of the FAT in the head locked position, and as the container is lowered the plunger moves the stop to allow the bias to rotate the indexing means to rotate the FAT to the head open position to allow the container to be lifted away without the coupler.

35. A rig according to claim 34 in which the tail of the FAT is rotated by the indexing means towards an abutment there by restricting the space needed by a hook of the FAT to be withdrawn from the socket in the indexing means, yet allowing enough space for the FAT to deflect and free its head from the corner fitting.

36. A rig according to any one of claims 33 to 35 in which when the FAT is in the head locked position locked in a corner fitting and the tail engaged with the indexing means is lifted upwards relative to the socket in the corner fitting by a spring to disengage an anti-rotation abutment on the head of the FAT to allow the head to rotate in the socket.

37. A rig according to any one of claims 33 to 36 in which spring biased guides are provided to centralize the FAT within the spaces into which it can be deflected.

38. A rig according to any one of claims 1 to 20 for processing SATs which includes a pair of modules having corner units each having a top plate for supporting a container being lowered onto the corner unit, the top plate having an aperture through which the SAT projects, the SAT being held in an indexing means below the

top plate and having a socket which holds the SAT in a head open position ready to engage a lower fitting socket aperture of the container being lowered onto the pair of modules.

39. A rig according to claim 38 in which an operating toggle wire of the SAT, which moves the SAT between its various rotational positions, is supported on a guide on the top of each corner unit, the guide guiding the toggle wire clear of the toggle wire catches on the SAT during the fitting operation of the SAT by the rig.
40. A rig according to any one of claims 1 to 39 in which each corner unit is spring mounted from the structure extending between the corner units to allow the corner units to move horizontally and vertically as the couplers find their way into the sockets of the indexing means.
41. A rig according to any one of claims 1 to 40 in which one or more of the actuators comprises a spring retained in position by a trigger releasable stop.
42. A corner unit for processing FATs comprising an indexing means having a socket for receiving and holding the FAT in a defined position, a first actuating means for rotating the indexing means with the FAT about a vertical axis to engage or disengage a head of the FAT within the associated container corner fitting, and second actuating means for driving the indexing means with the FAT through a predetermined locus in a vertical plane to insert or with draw the FAT from the aperture in the associated corner fitting.
43. A corner unit for processing SATs in which an operating toggle wire of the SAT, which moves the SAT between its various rotational positions, is supported on a guide on the top of each corner unit, the guide guiding the toggle wire clear of the toggle wire catches on the SAT during the fitting operation of the SAT by the rig.

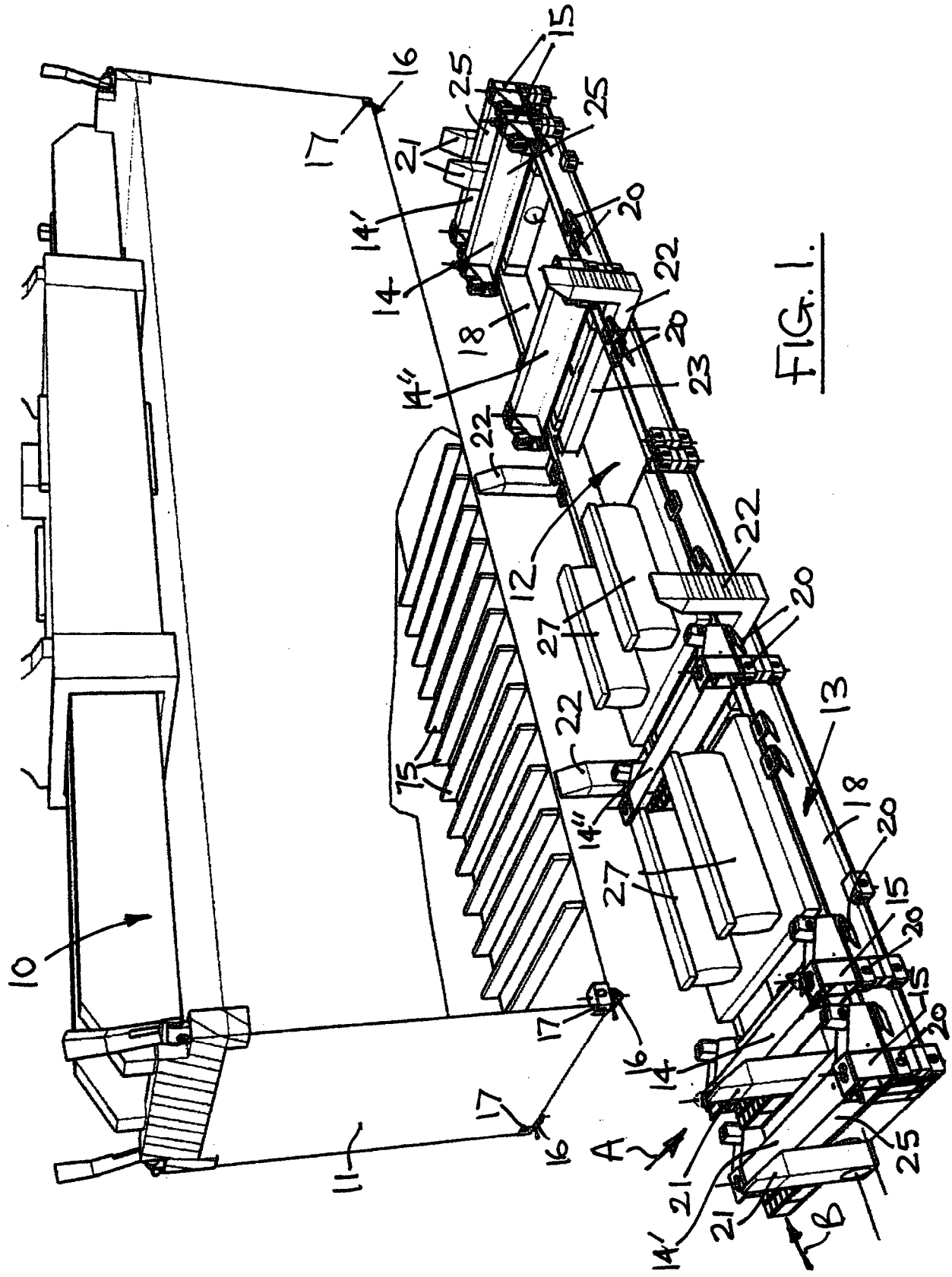


FIG. 1.

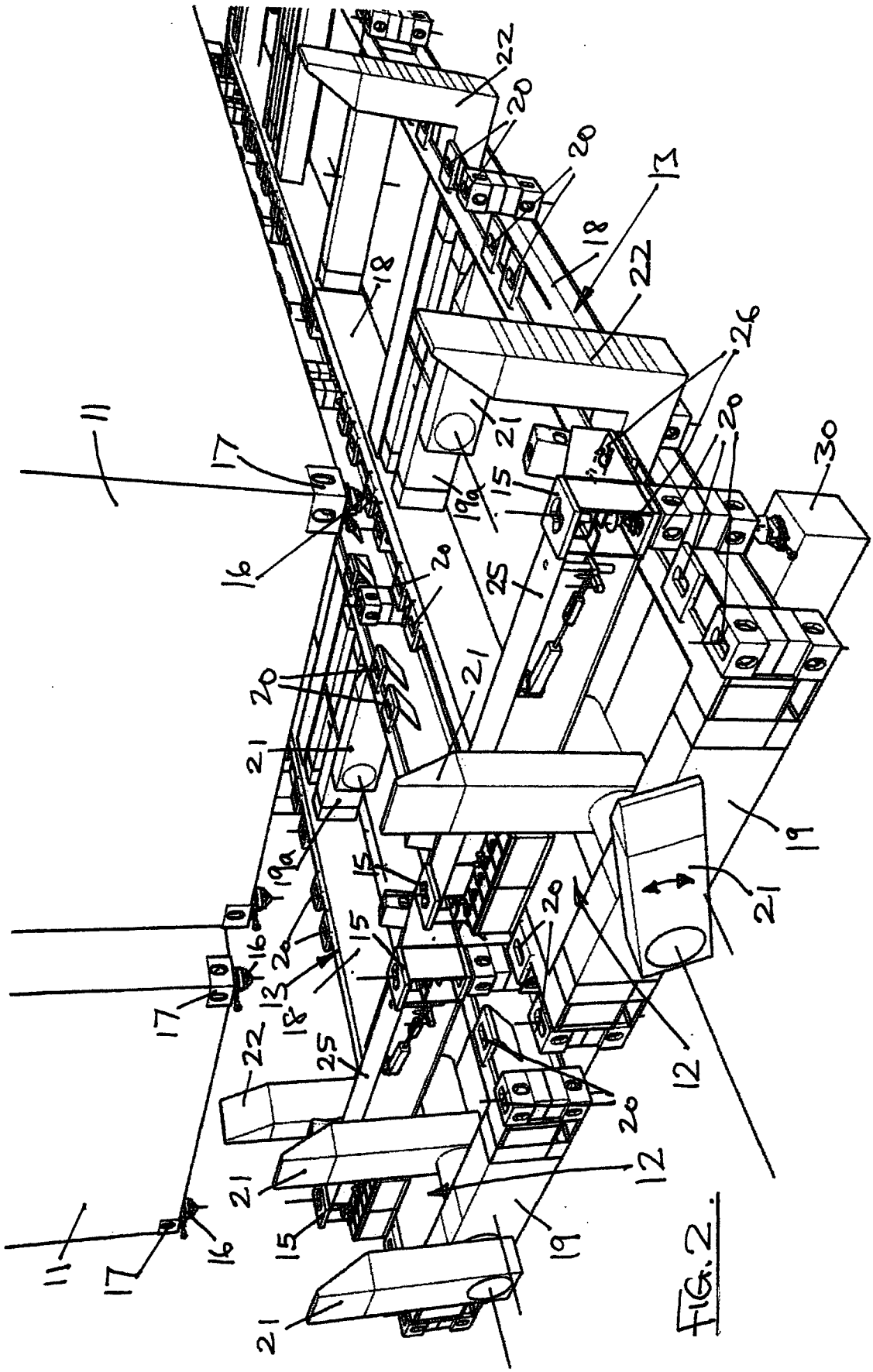


FIG. 2.

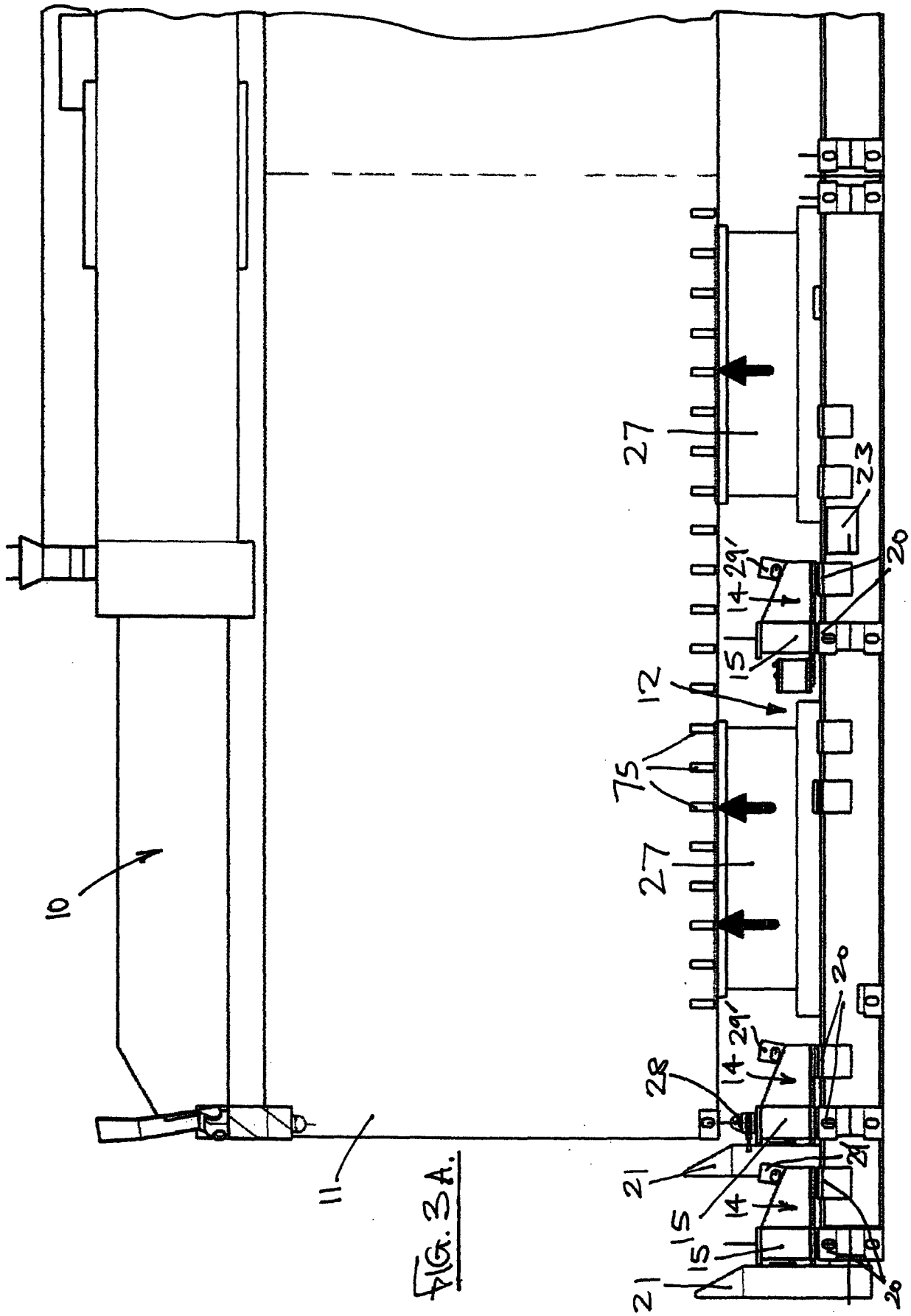
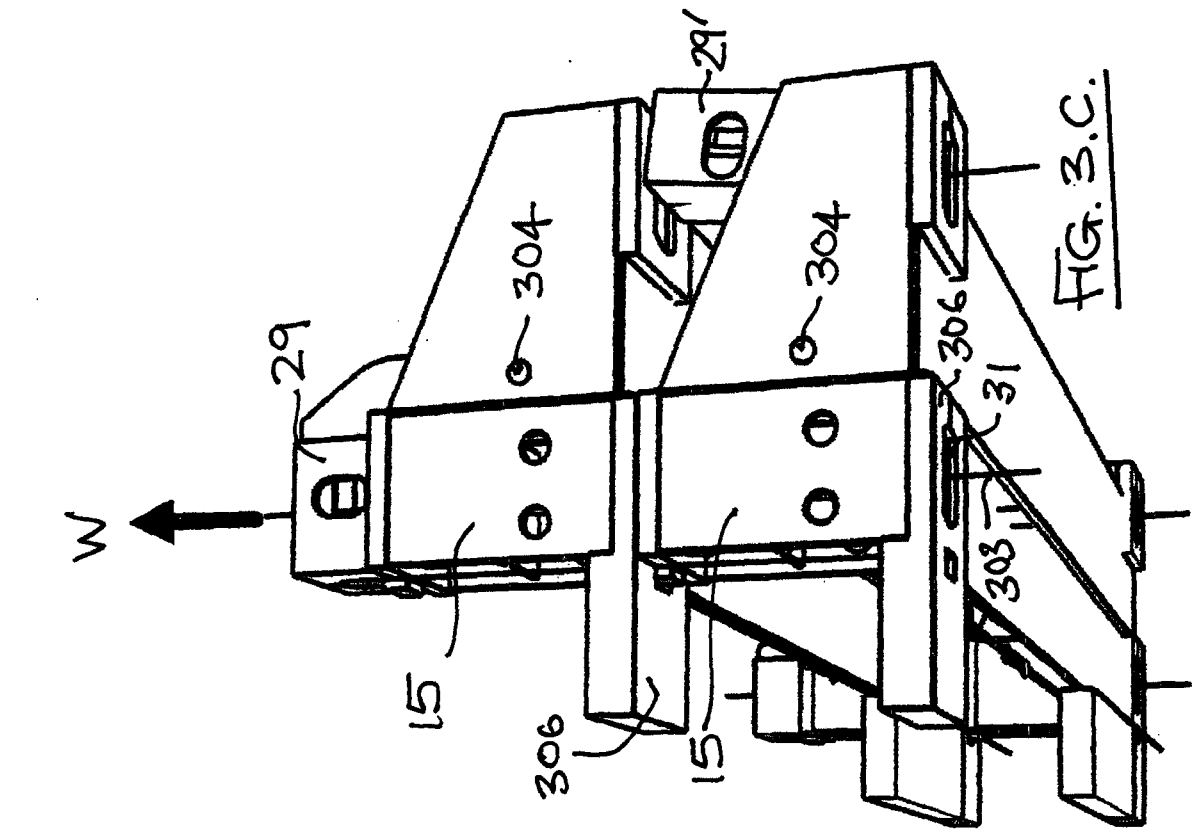


FIG. 3A.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29'
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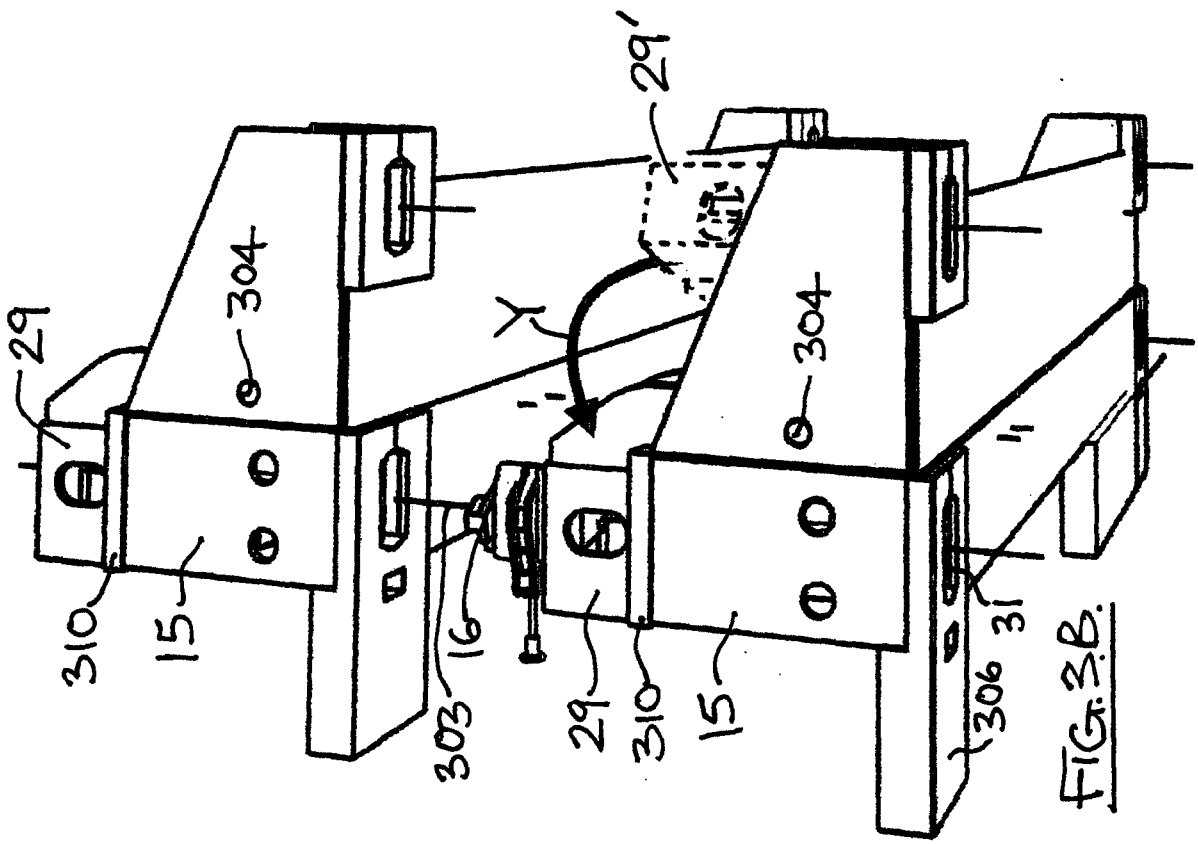
FIG. 3.C.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29'
Y
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306
31

FIG. 3.B.

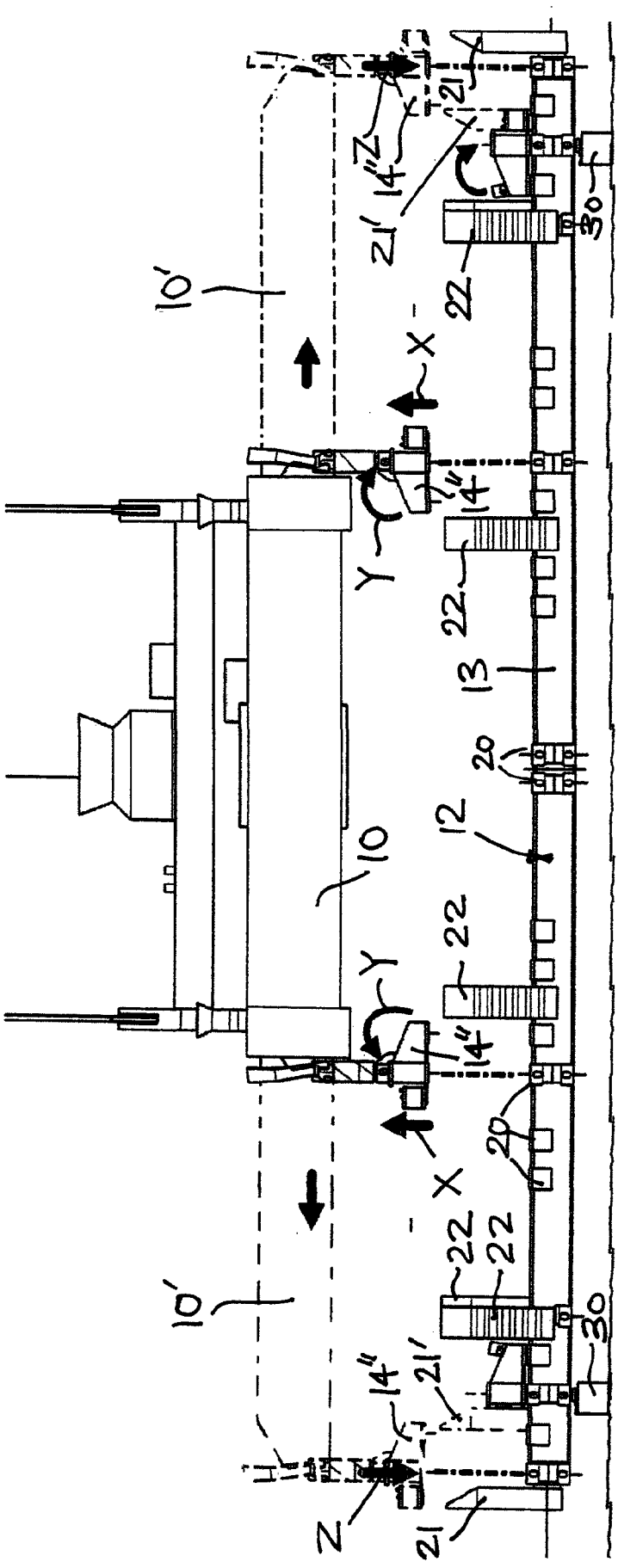


FIG. 4.

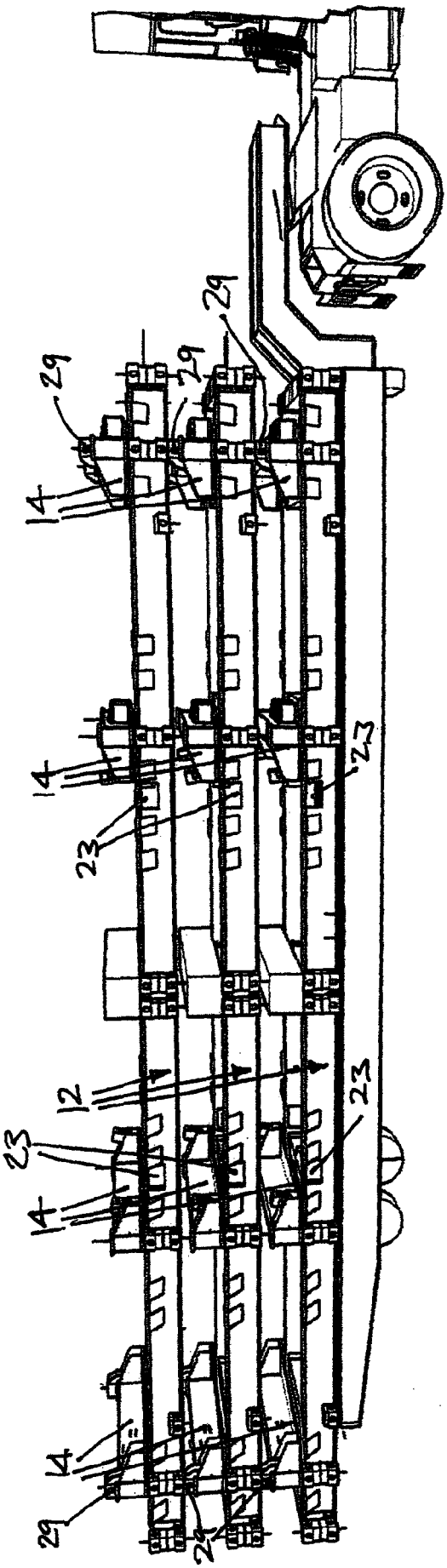
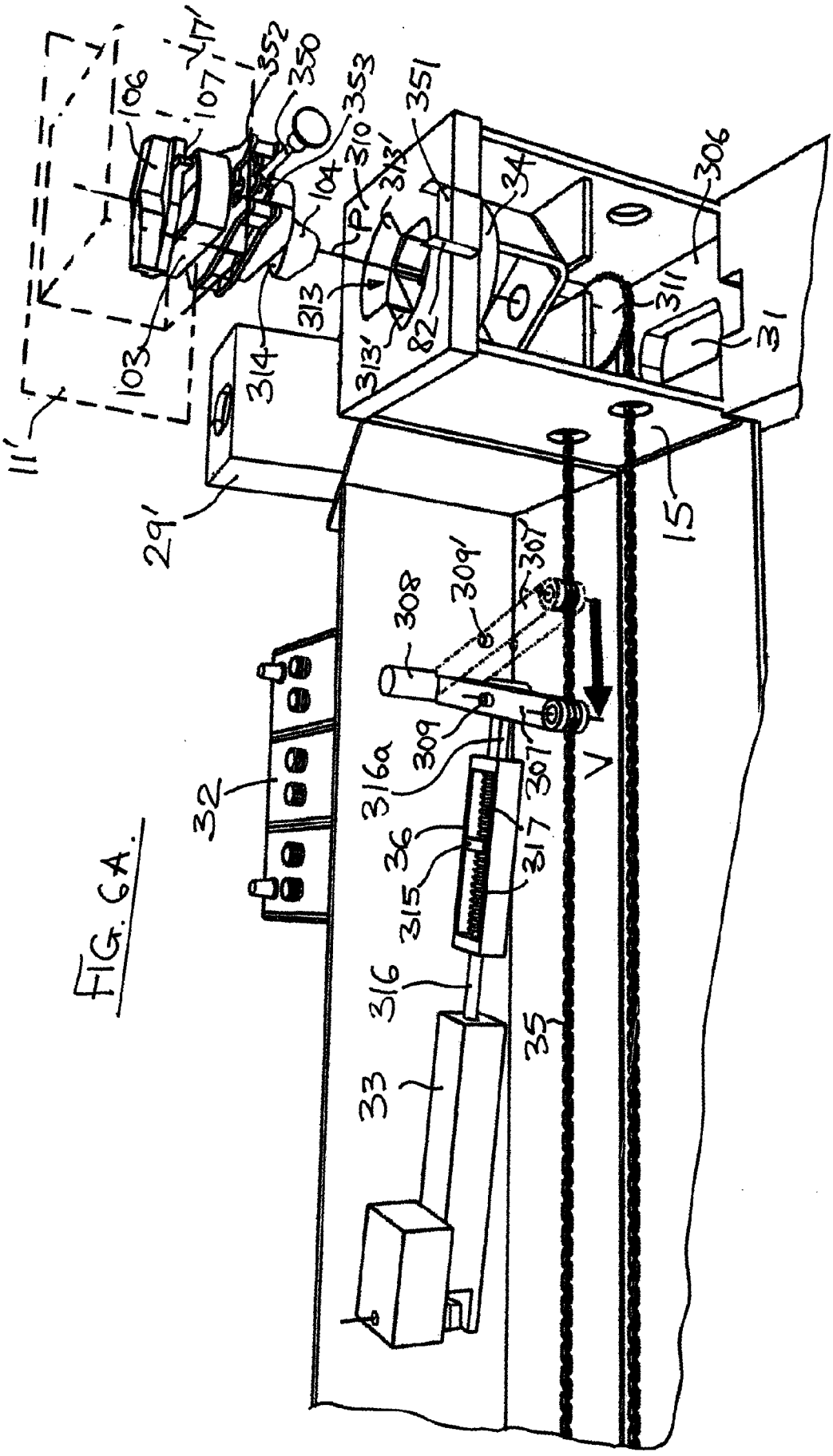


FIG. 5.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313'
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82
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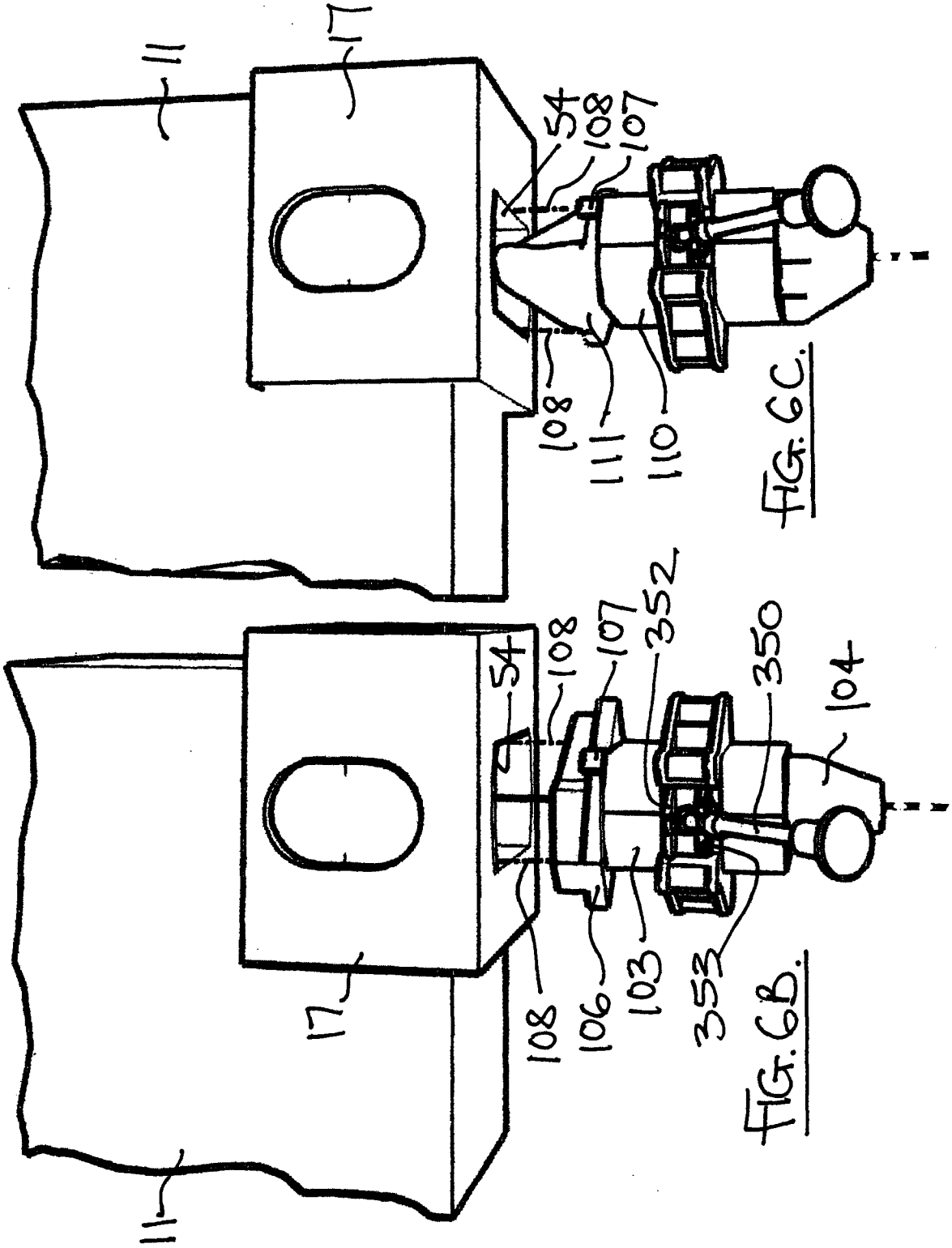
31
314
29'
15
308
309'
307'
309
316a
307
32
36
317
315
316
35
33

FIG. 6A.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17
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108
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108
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17
54
108
107
352
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104
108
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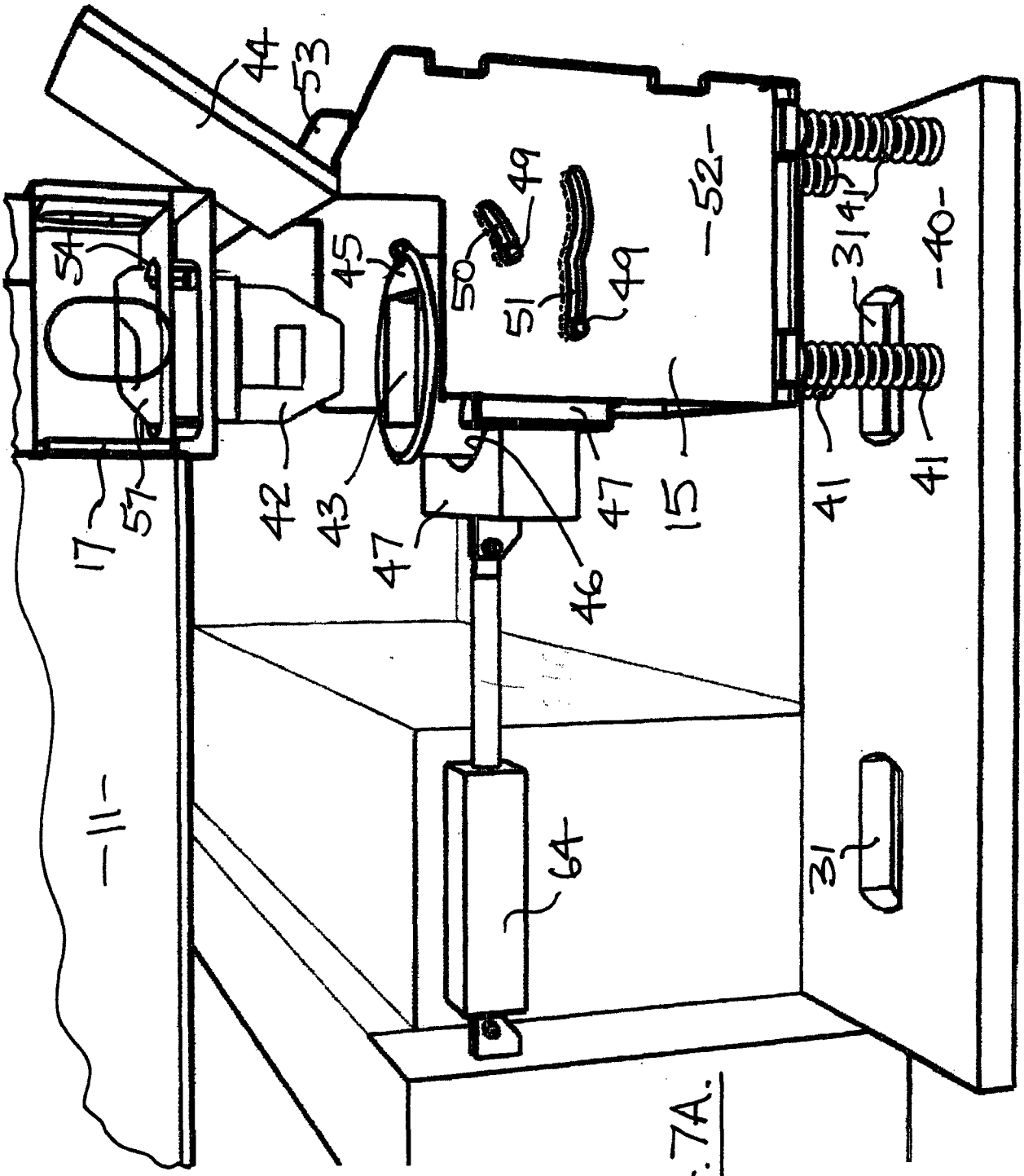
103
353

FIG. 6C.

FIG. 6B.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45
50
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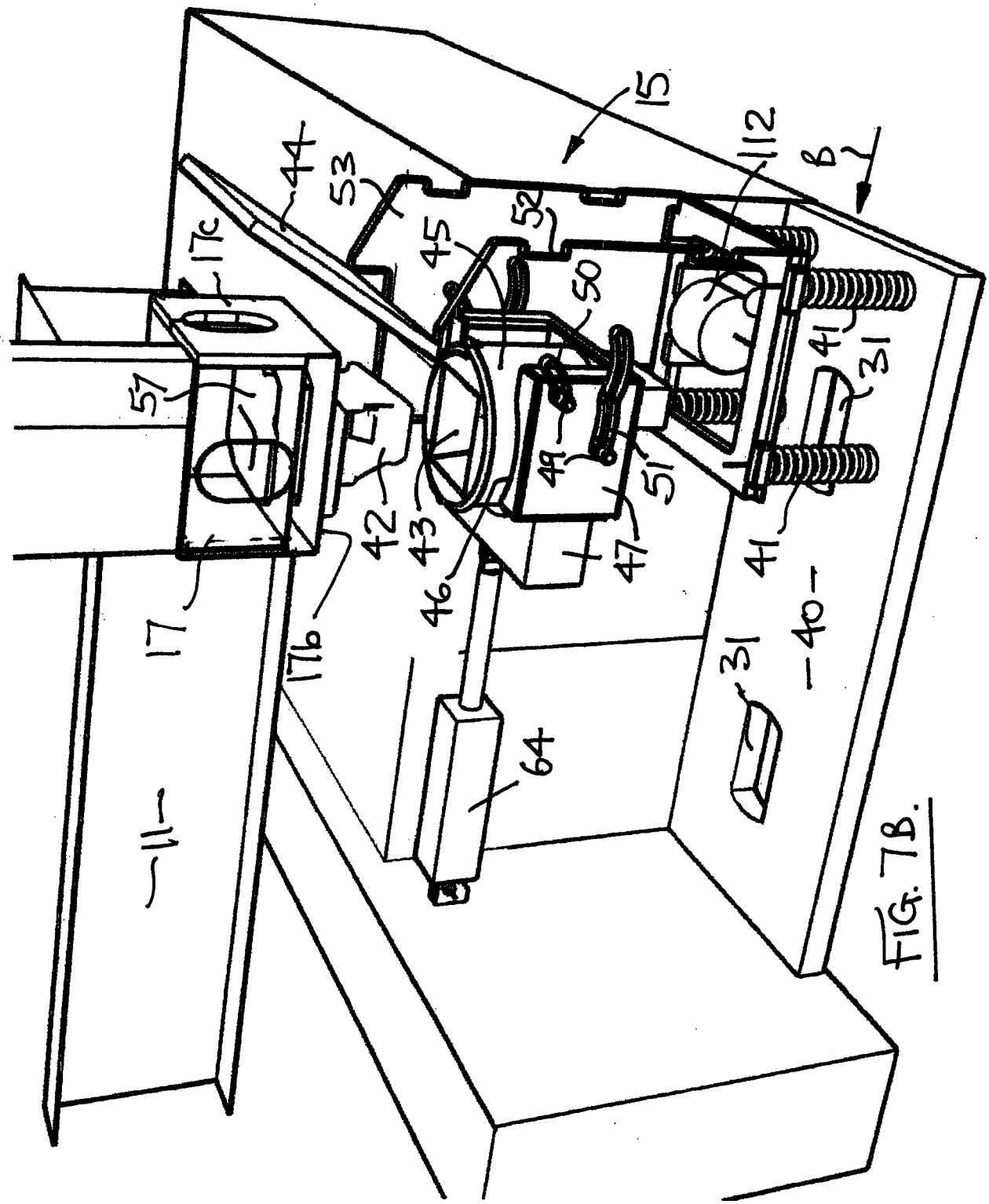
41
17
57
47
46
11
64
31

FIG. 7A.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112
B
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53
52
45
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17c
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41
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49
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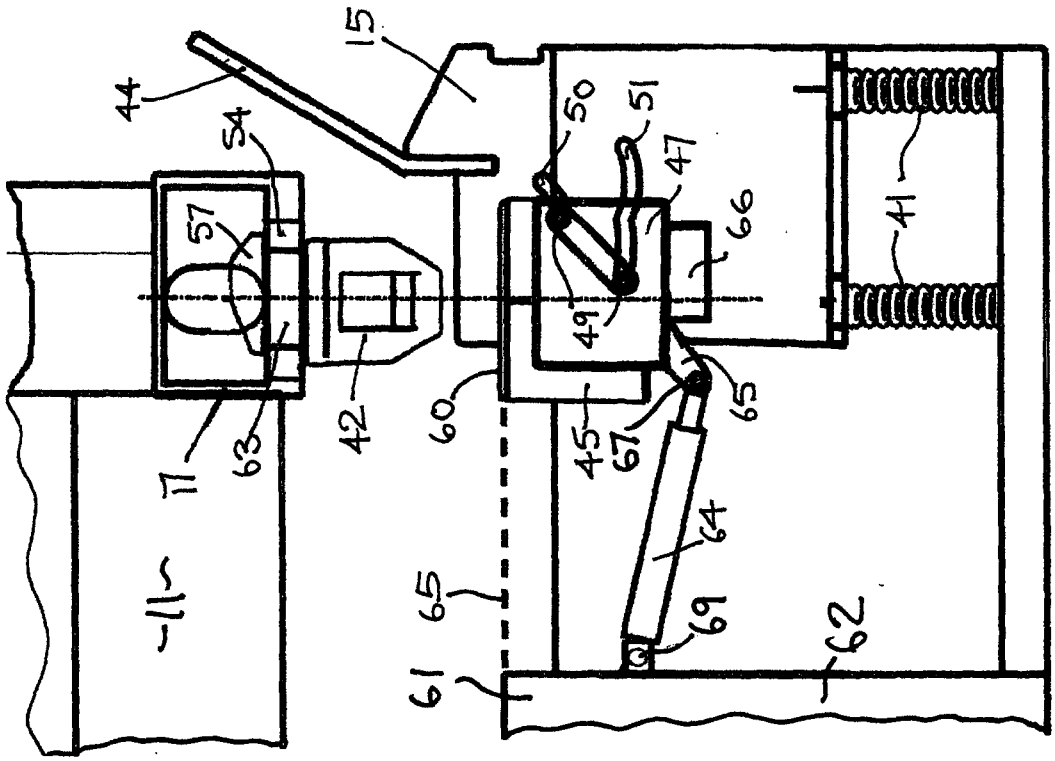
46
41
17
17b
40
31
64
11

FIG. 7B.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44
54
57
50
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47
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41
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42
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45
67
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64
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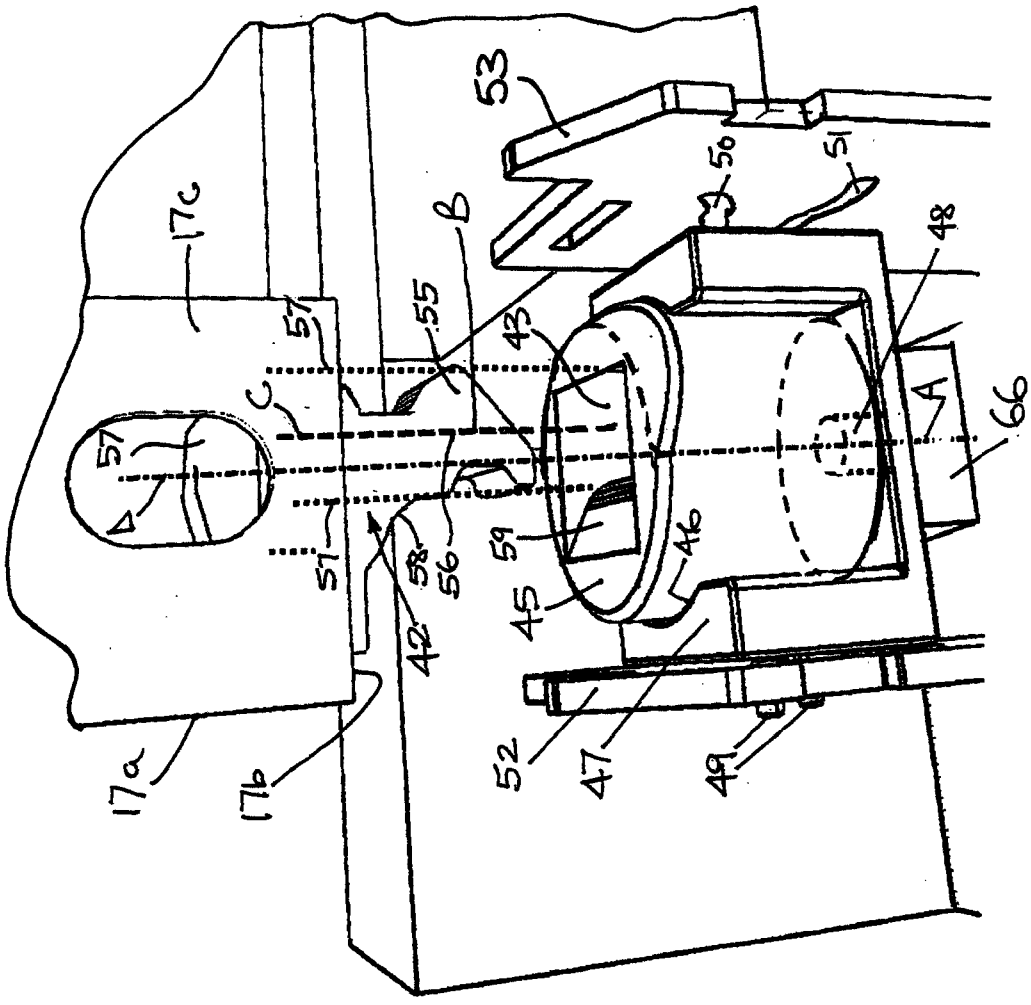
17
11
65
69
61
62

FIG. 9.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17c
B
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C
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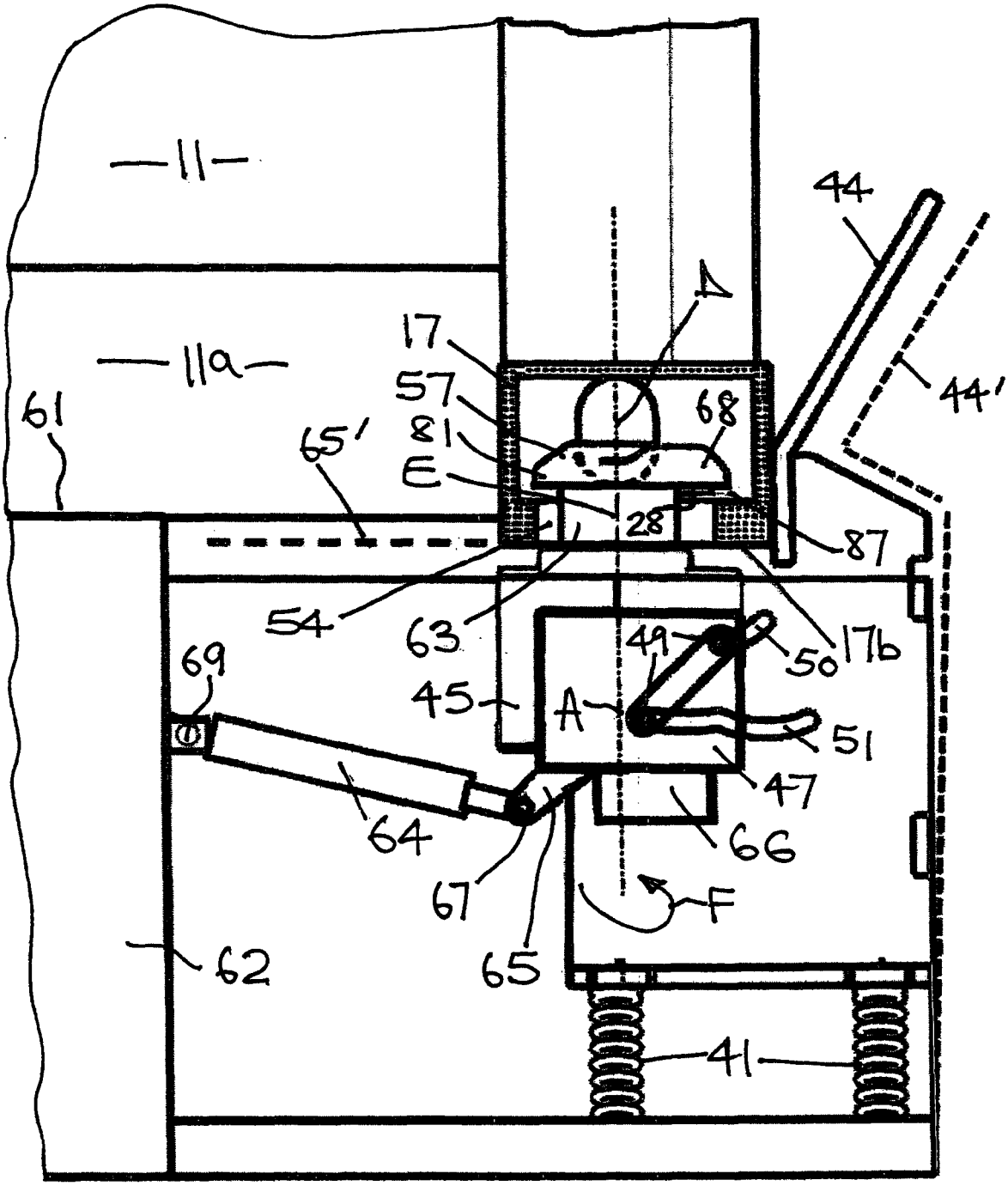
42
52
47
49
17a
17b

FIG. 8.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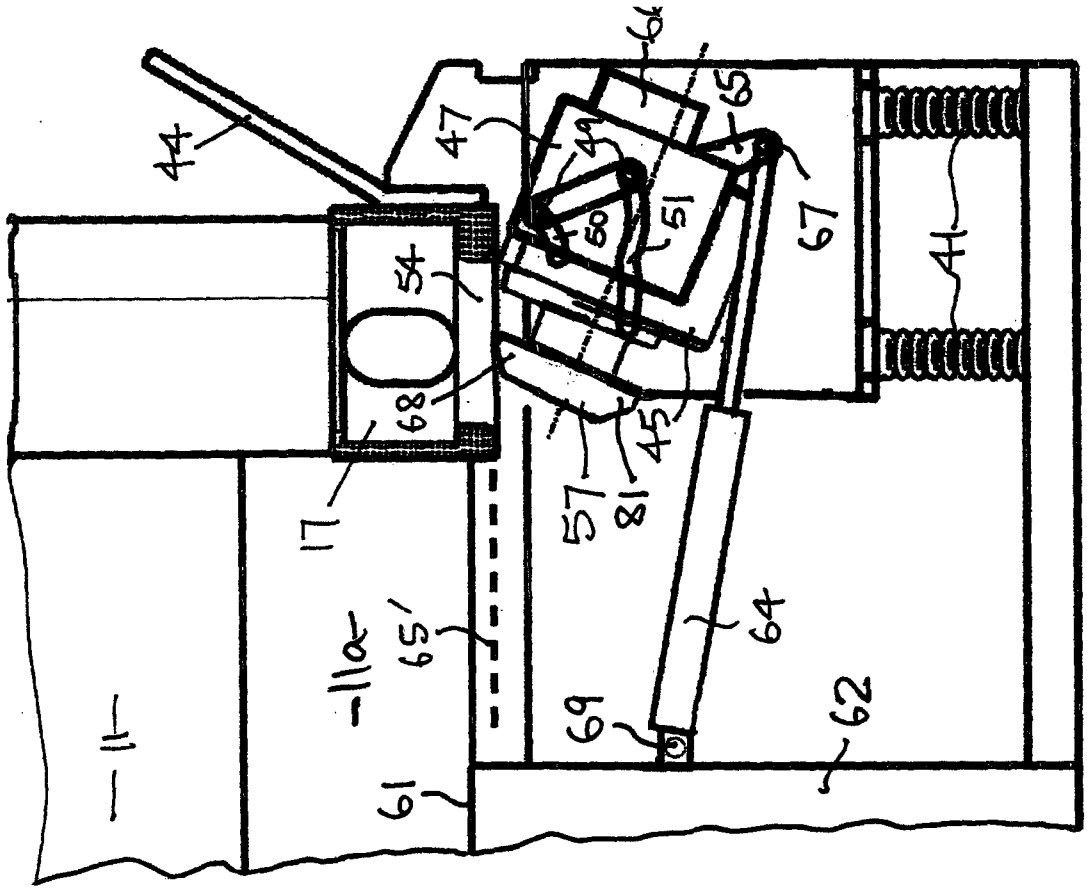
11a
61
65'
17
57
81
E
A
68
44
44'
28
87
54
63
49
50
17b
69
45
A
51
47
64
66
67
F
65
62
41

FIG. 10.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67
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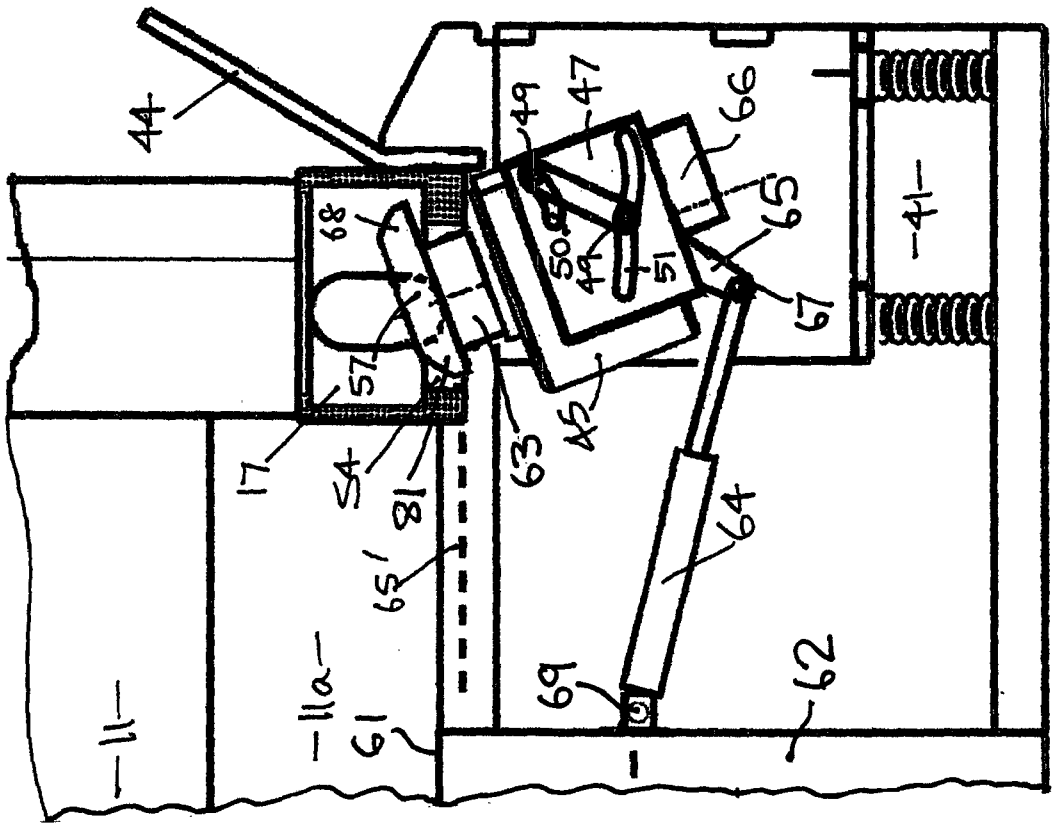
51
54
41
68
45
57
81
17
65'
64
11a
11
69
62
61

FIG. 12.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81
65'
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11a
11
69
62
61

FIG 11.

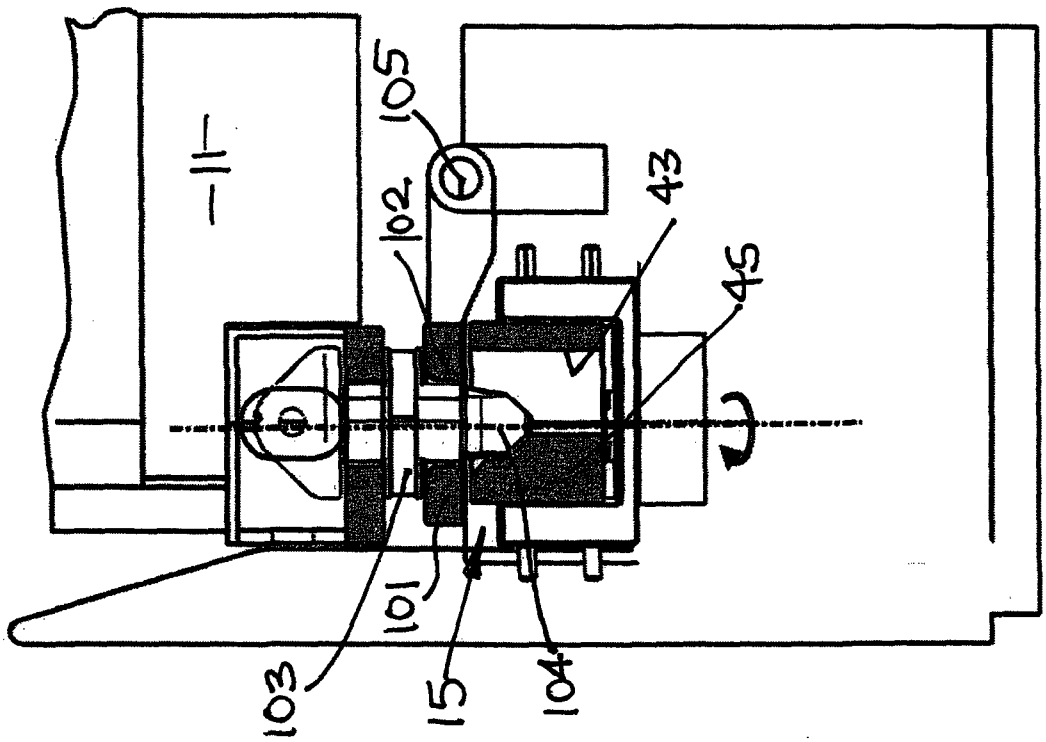


FIG. 13B

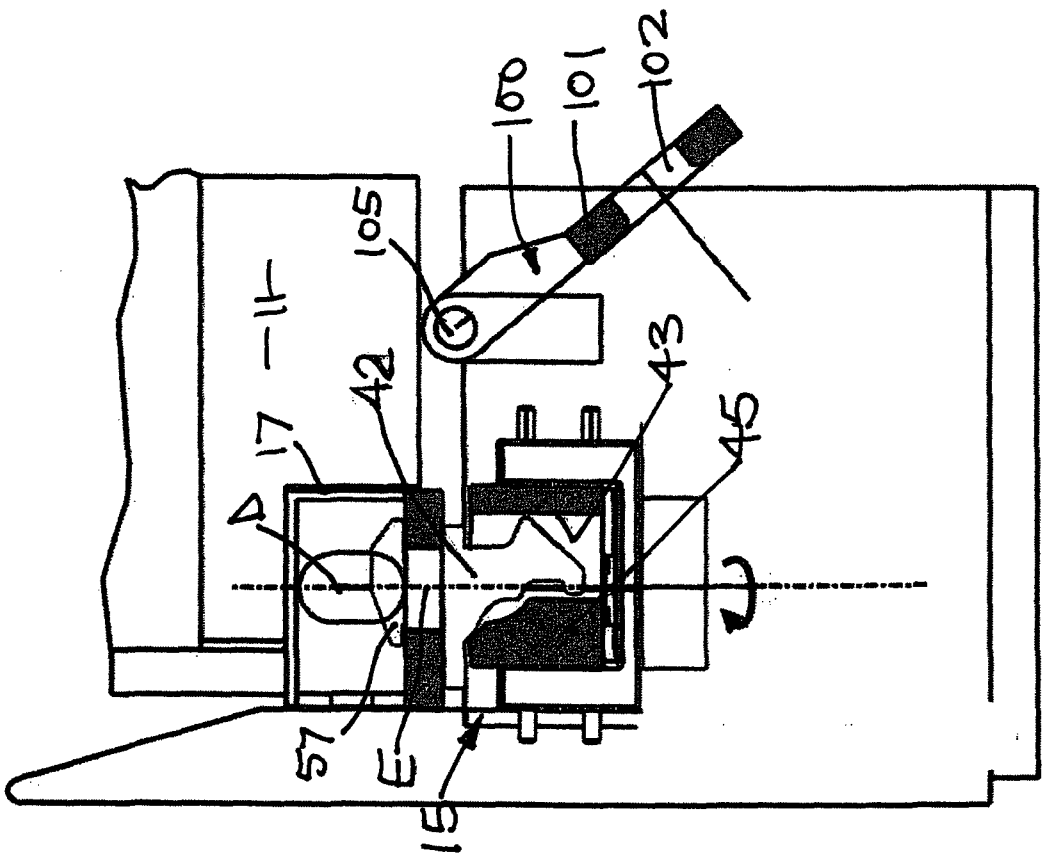
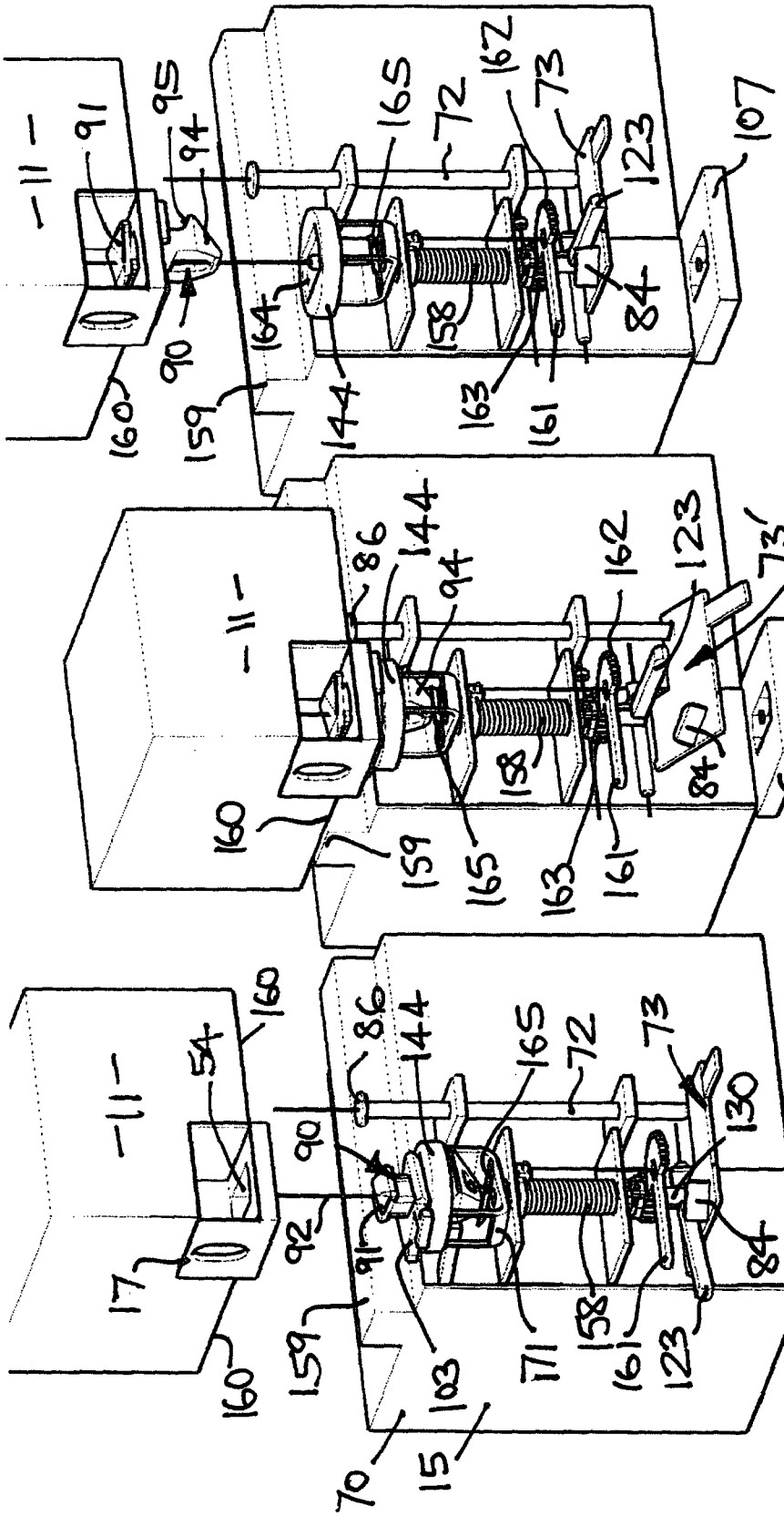


FIG. 13A


11
91
95
94
90
160
159
164
144
165
72
167
73
123
107
158
84
163
161
FIG. 14C
11
86
144
94
162
123
73'
158
84
160
159
165
163
161
107
FIG. 14B
11
160
54
86
144
165
72
73
107
90
130
92
91
84
17
159
103
171
158
161
123
106
160
70
15
FIG. 14A

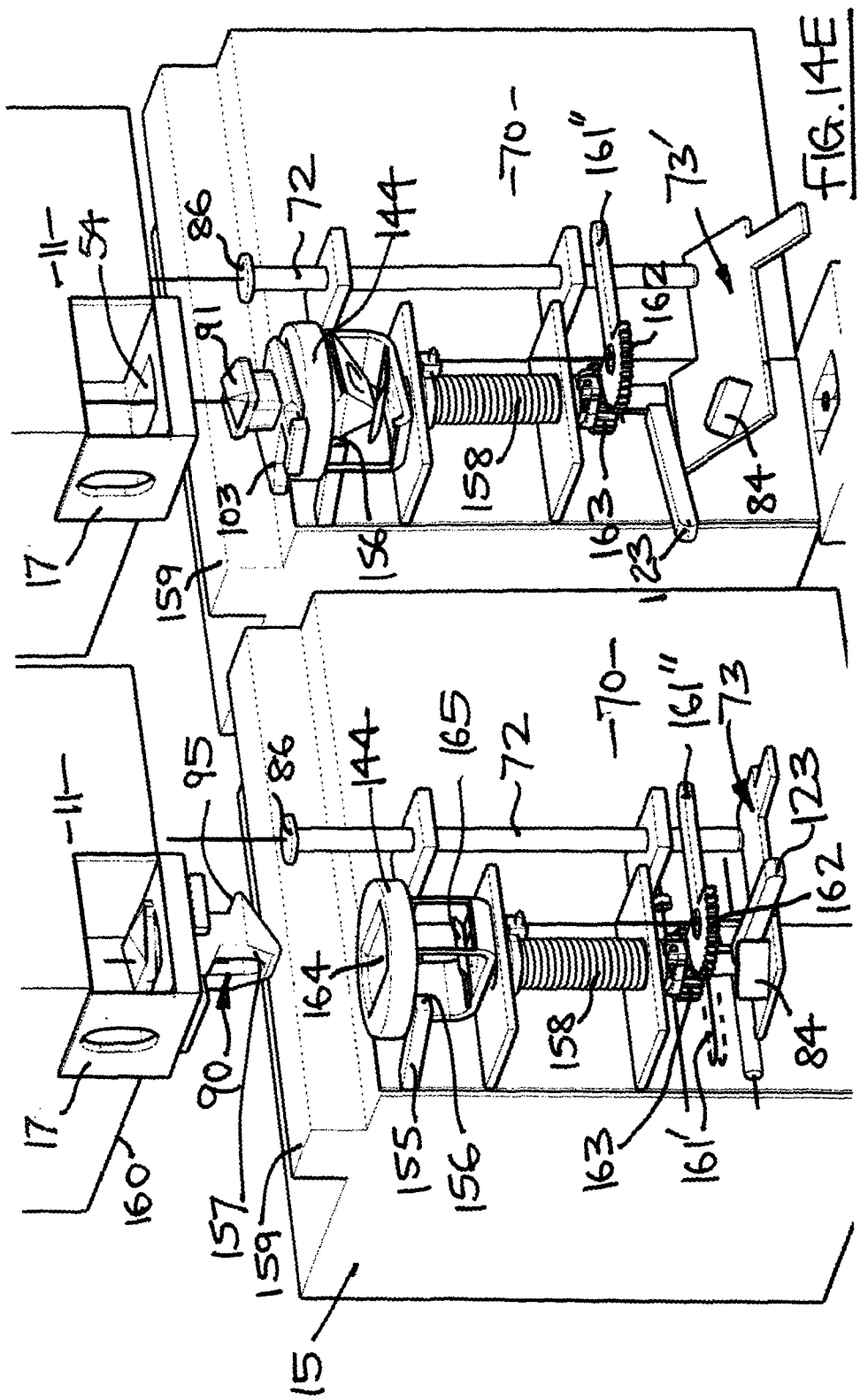


FIG. 14E

FIG. 14A

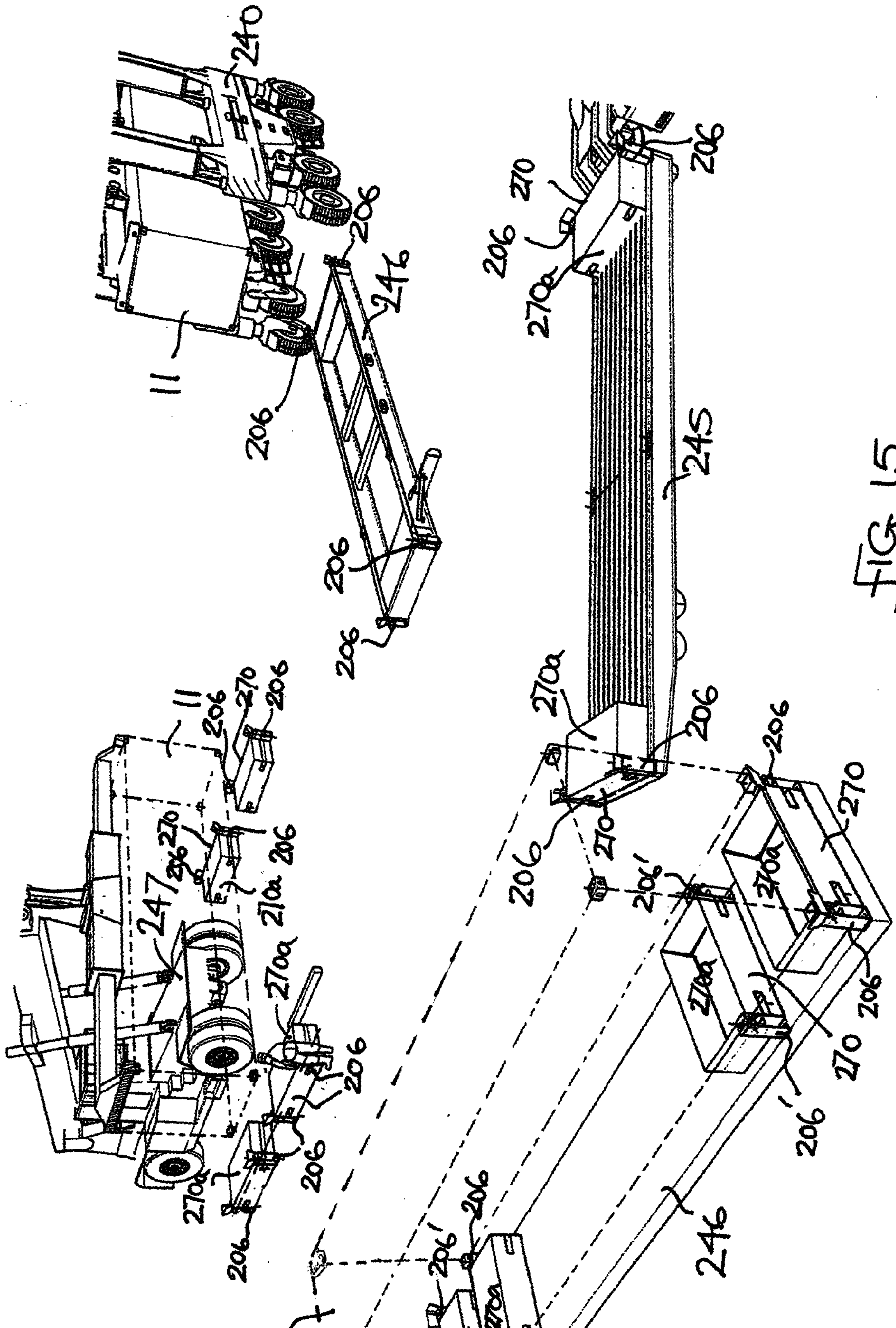


FIG. 15.

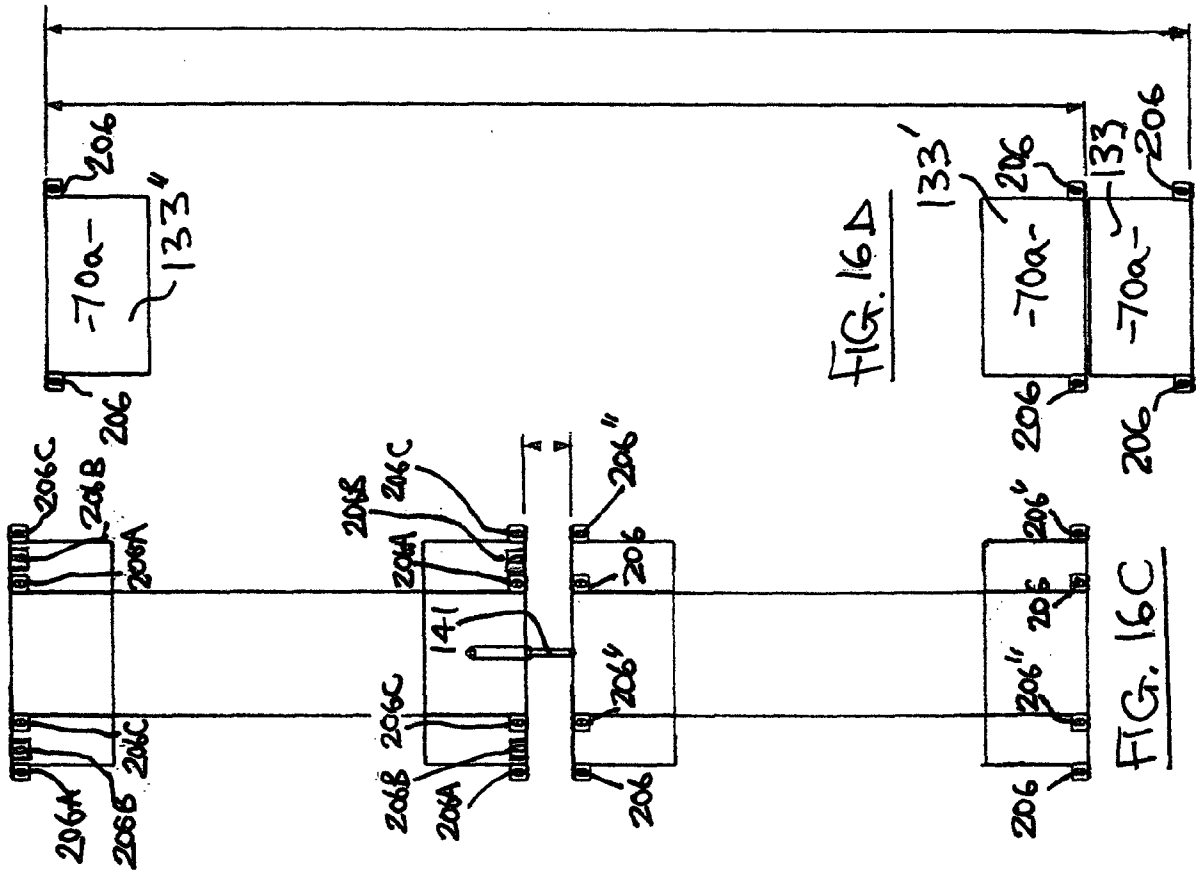


FIG. 16D

FIG. 16C

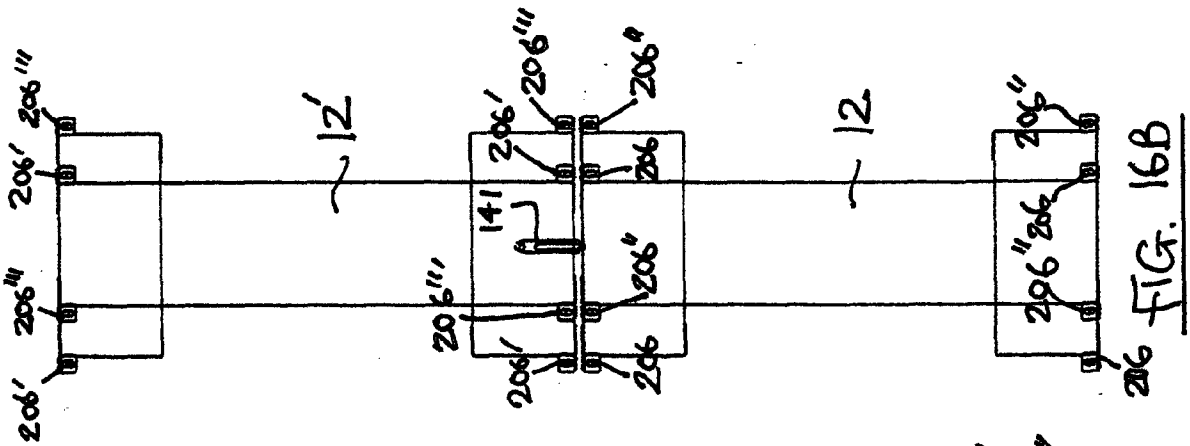


FIG. 16B

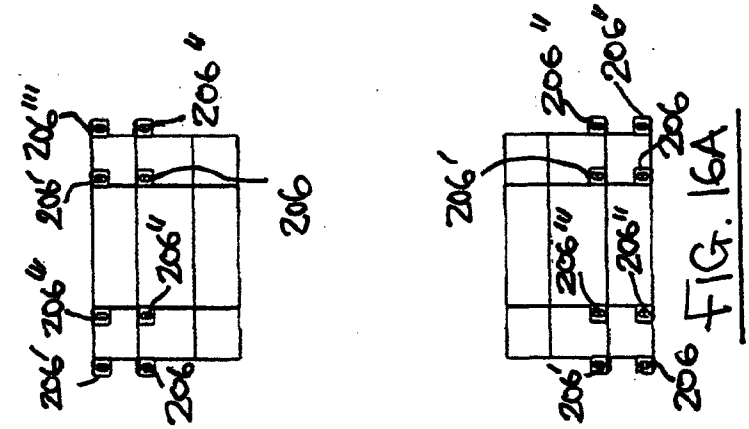


FIG. 16A

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2020/000014

A. CLASSIFICATION OF SUBJECT MATTER
INV. B66C1/10 B66C15/00 B65D88/12 B65D90/00
ADD.

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)
B66C B65D

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/096877 A1 (SHIP TO SHORE TECHNOLOGY HOLDNING B V [NL]; BOHMAN KARL [SE]) 11 August 2011 (2011-08-11) page 9, line 7 - page 17, line 5; figures 1-17	1,2,11
X	WO 2004/065264 A1 (NOELL CRANE SYS GMBH [DE]; WEIS OTTO [DE]) 5 August 2004 (2004-08-05) page 7, line 23 - page 13, line 14; figures 1-20	1,2,11
X	DE 10 2009 031272 B3 (KALP GMBH [DE]) 30 December 2010 (2010-12-30) paragraph [0027] - paragraph [0044]; figures 1-8	1,2,11

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

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"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
13 May 2020	31/07/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lämmel, Gunnar

1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2020/000014

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1, 2, 11

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2, 11

   A rig for connecting or disconnecting container couplers to or from the four lower corner fittings of a shipping container, the rig comprising two pairs of corner units held in the required transverse special relationship by a structure extending between the two corner units of each pair to form two operating modules, and a base member having sockets and/or other connectors to secure the operating modules to the base member to enable the corner units of the modules to simultaneously engage all the four lower corner fittings of a container lowered onto the rig, each corner unit including an indexing means for engaging and manipulating an associated coupling to connect or disconnect the coupling to or from its associated container corner fitting with details of the connectors/ sockets.

   ---

2. claims: 3-6, 13-15, 19, 20

   Details of the base.

   ---

3. claims: 8-10, 12

   Details of the modules.

   ---

4. claims: 7, 16-18

   Details of the corner units.

   ---

5. claims: 21-37, 42

   Rig with fully automatic twistlocks and corner unit therefore.

   ---

6. claims: 38-41, 43

   Rig with semi-automatic twistlocks and corner unit therefore.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2020/000014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011096877 A1	11-08-2011	CN 102428013 A	25-04-2012
		CN 102428016 A	25-04-2012
		EP 2531421 A1	12-12-2012
		EP 2531428 A1	12-12-2012
		JP 2013518787 A	23-05-2013
		JP 2013518788 A	23-05-2013
		SE 1050107 A1	04-08-2011
		SG 182671 A1	30-08-2012
		SG 182672 A1	30-08-2012
		US 2012288349 A1	15-11-2012
		US 2012321418 A1	20-12-2012
		WO 2011096877 A1	11-08-2011
		WO 2011096878 A1	11-08-2011
WO 2004065264 A1	05-08-2004	AT 347521 T	15-12-2006
		DE 10301197 A1	19-08-2004
		EP 1585690 A1	19-10-2005
		JP 2006516014 A	15-06-2006
		KR 20050092756 A	22-09-2005
		WO 2004065264 A1	05-08-2004
DE 102009031272 B3	30-12-2010	AU 2010268517 A1	16-02-2012
		DE 102009031272 B3	30-12-2010
		DK 2448844 T3	27-04-2015
		EP 2448844 A1	09-05-2012
		ES 2531416 T3	13-03-2015
		NZ 597726 A	21-12-2012
		PL 2448844 T3	31-08-2015
		PT 2448844 E	30-03-2015
		SG 178168 A1	29-03-2012
		US 2012167382 A1	05-07-2012
		WO 2011000336 A1	06-01-2011
		ZA 201200197 B	26-09-2012