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(54) **VERTICAL STORAGE CONVEYOR WITH IMPROVED LOAD SUPPORT AND DRIVE SYSTEM**

VERTIKALER SPEICHERFÖRDERER MIT VERBESSERTEM LASTTRÄGER UND ANTRIEBSSYSTEM

TRANSPORTEUSES A STOCKAGE VERTICAL POURVUES D'UN SUPPORT DE CHARGE ET D'UN SYSTEME D'ENTRAINEMENT AMELIORES

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Description

[0001] The invention relates to a vertical conveyer with the features cited in the preamble of claim 1.

[0002] A vertical conveyor of this type is described in US-3,547,281. It teaches to insert the through pin through a hole of said pick-up arm so that the through pin projects at both sides. The projecting ends of the through pin are respectively connected to one strand of the pick-up drive chain. The pick-up arm is rotatable with respect to the pick-up drive chain so that it can be adjusted for engaging and driving the compression chain. The engagement with the compression chain has to be accurate enough for correct operation of the vertical conveyor.

[0003] Other vertical conveyors are described in US-3,424,321 and 3,656,608.

[0004] It is the object of the present invention to provide an improved vertical conveyor of the above-mentioned type with an improved handling and maintenance work, said conveyor providing at least the same balance, stability and force for raising the load supports in operation.

[0005] According to the present invention, this object is attained by a vertical conveyor with the features defined in claim 1.

[0006] This construction allows to disassemble each pick-up arm separately from the unit without disturbing the orientation of the pick-up and compression chains. If a defect with one of the pick-up arms or in connection with the compression chain occurs, the respective pick-up arm can be removed from the through pin by e.g. splitting the pick-up arm in the upper head portion and the lower tail portion. If desired, the through pin can remain in connection with the strands of the chain during the repair.

[0007] Advantageous features and embodiments of the invention are cited in the independent claims.

[0008] In one subsidiary aspect of the invention, first and second drive chain assemblies may be present and each comprises a pickup drive chain which drives a compression chain supporting the load supports, and an upper drive sprocket of the pickup drive chain driven by a motor wherein a substantial amount of the load exerted by the supports against the pickup drive chain is imparted against the upper drive sprocket. An idler sprocket is aligned below the drive sprocket and has a smaller diameter than the drive sprocket. Thus, the slack produced in the pickup drive chain is minimized such as occurs during reversing motion of the conveyor.

[0009] In one subsidiary aspect of the invention, a plurality of pickup arms may be present which are pivotally connected to the pickup drive chain such that the pickup arms engage and drive the compression chain so as to move the load supports. The pickups are pivotally mounted offset on the pickup chain to aid in engagement of the pickups with the compression chain. The compression chain includes an endless roller chain comprised of interconnecting, elongate compression links and transverse axles mounted at each end of the compression links such that the pickup arms engage the axles for pushing the compression links upward. The offset mounting of the pickups enables receiving notches on the pickups to engage the axles as the chain moves in its lower portion of the loop.

[0010] In one subsidiary aspect of the invention, the load supports may include load support mounting arms, which are pivotally mounted to the compression links. A mounting member extends in the support spacing. The motor is mounted to the mounting member. A connecting member supportingly connects the first and second frame sections. The motor mounting member is suspended from the connecting member substantially centrally between the frame members.

[0011] In still another subsidiary aspect of the invention, the pickup chain may comprise two spaced roller chains. Each through-pin connects the roller chains. The pickups are pivotally connected to the roller chain between the pickups. The pickup chain also includes a link, and a link pin interconnecting the link. The through-pins are offset from the link pins. The pickups comprise an upper head portion and a smaller lower bifurcated tail portion. The upper head portion includes opposing receiving notches for engaging the through-pins of the compression chain.

[0012] In one subsidiary aspect of the invention, as a pan traverses through the top transfer guide, the guide moves upward and then returns to its original height. In addition, as the compression chain links shorten over the life of the conveyor, the reference starting point for the top transfer guide moves slightly downward.

[0013] As the pan traverses through the bottom transfer guide, a vibration develops due to a lack of dampening of the guide motion which moves downward from a reference point and returns. The present invention provides for a vertical floating motion with the possibility of a dampening effect.

[0014] In still another subsidiary aspect of the invention, a positive locking device prevents movement of the compression chain while the rotational movement of the pan is at rest. The locking device is capable of transferring any load imbalance to the frame structure.

[0015] In accordance with the present invention, a vertical conveyor has a frame with a first vertical frame section and a second vertical frame section spaced apart from, but supportingly connected thereto. A looped compression chain is mounted respectively to each of the first and second frame sections. A plurality of load supports have first and second ends, with each load support being capable of holding a load to be conveyed around in a looped path. A support mechanism interconnects the compression chain and respective first and second ends of the load supports so that the compression chains support the load supports such that as one support is conveyed upwardly, another load support is conveyed downwardly. The load supports pass

through a predetermined, spaced apart, horizontal distance, which defines a support spacing.

[0016] First and second pick-up drive chain assemblies are mounted respectively to each of the first and second frame sections. A plurality of pick-up arms are pivotally connected to each pick-up drive chain assembly, and the pick-up arms engage and drive the compression chain.

[0017] A motor is mounted within the spacing defined by the load supports. A first drive shaft connects the motor to the first pick-up drive chain assembly and a second drive shaft connects the motor to the second pick-up drive chain assembly. The drive shafts simultaneously drive the first and second drive chain assemblies so that the pick-up arms engage and drive the compression chain and move the load supports.

[0018] In one subsidiary aspect of the present invention, the pick-ups are pivotally mounted offset on the pick-up drive chain assembly to aid in engagement of the pick-ups with the compression chain. Each pick-up drive chain assembly comprises two spaced roller chains and a through-pin interconnecting the roller chains. The pick-up arms are pivotally connected to each through-pin. The pick-up drive chain assembly includes a link and a link-pin interconnecting the links. The through-pins are offset from the link-pins. The pick-up arms comprises an upper head portion and a smaller, lower bifurcated tail portion. The compression chain includes axles, and the upper head portion includes two receiving notches for receiving axles positioned on the compression chain.

[0019] The mounting member preferably mounts the motor substantially centrally between the frame sections. The motor may be an electrical motor having first and second motor shaft ends, located at respective sides of the motor, and respectively connected to the first and second drive shafts. The motor may be mounted at a vertical height less than one half the vertical height of the vertical frame sections.

[0020] In another subsidiary aspect of the present invention, each compression chain also includes an endless roller chain comprising interconnecting, elongate compression links and transverse axles mounted at each end of the compression links. Each load support also includes load support mounting arms at first and second ends of the load supports. The mounting arms are pivotally connected to the compression links so that the load supports are supported by the compression chain. Pick-up arms are pivotally connected to each pick-up drive chain assembly, such that the pick-up arms engage the axles while pushing the compression links upward.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The foregoing advantages of the present invention will be appreciated more fully from the following description, with reference to the accompanying drawings, in which:

[0022] Figure 1 is a front and elevational view of a vertical conveyor according to one embodiment of the present invention.

[0023] Figure 2 is a side elevation view of the vertical conveyor shown in Figure 1.

[0024] Figure 3 is an enlarged, front elevational view of the major weldment of the frame and depicting the pickup drive chain mechanism for the vertical conveyor.

[0025] Figure 4 is an enlarged front elevational view similar to figure 3, showing features of the endless pick-up chain drive and of the secondary compression chain lock.

[0026] Figure 5 is an enlarged, front elevation view of the front upper guide plate subassembly.

[0027] Figure 6 is an enlarged side elevation view looking in the direction of arrow 6 of Figure 4.

[0028] Figure 7 is an enlarged from elevation view of the drive gear sprocket.

[0029] Figure 8 is a cross-sectional view taken along line 8-8 of Figure 7.

[0030] Figure 9 is an enlarged engineering scale front elevation view of the idler sprocket.

[0031] Figure 10 is a cross-sectional view taken along line 10-10 of Figure 9.

[0032] Figure 11 is an enlarged front elevation view of one of the pickup arm assemblies which engages with and conveys a compression link in the secondary chain.

[0033] Figure 12 is a sectional view taken along line 11-11 of Figure 12.

[0034] Figure 13 is a front elevation view of the doublestranded conveyor chain in the pickup drive chain.

[0035] Figure 14 is a sectional view of the pickup chain taken along line 14-14 of Figure 13.

[0036] Figure 15 is an enlarged side elevation view of the bottom pickup guide assembly.

[0037] Figure 16 is an enlarged plan view depicting the mounting and stabilizing structures of one end of a conveyed pan.

[0038] Figure 17 is a sectional view of the upper column section.

[0039] Figure 18 is a sectional view of the lower column section taken along line 18-18 of Figure 1.

[0040] Figure 19 is an enlarged, front elevation view of the top stabilizing transfer guide assembly.

[0041] Figure 20 is a top plan view of the conveyor shown in Figure 1.

[0042] Figure 21 is a partial rear elevation view taken along line 21-21 of Figure 20 and showing the guide channel cross-over.

[0043] Figure 22 is an enlarged, front elevation view of the bottom stabilizing transfer guide assembly.

[0044] Figure 23 is a side elevation of the bottom stabilizing transfer guide assembly shown in Figure 22.

[0045] Figure 24 is a top plan engineering scale view of the bottom stabilizing transfer guide assembly depicted in Figure 22.

[0046] Figure 25 is an enlarged, top plan view of the

tower locking assembly.

[0047] Figure 26 is an enlarged, front elevation of a portion of Figure 19 to delineate the shock mechanism.

[0048] Figure 27 is an enlarged section view of the sliding guide for the top transfer guide shown in Figure 26.

[0049] Figure 28 is an enlarged section view of Figure 27 delineating the friction mechanism components of the top transfer guide.

[0050] Figure 29 is a top plan view of the mounting and stabilizing structures which support a conveyed pan.

[0051] Figure 30 is a schematic, elevational view showing the compression chain supporting the load support.

[0052] Figure 31 is a front elevational view depicting the pick-up drive chain assembly and pick-up arms engaging the compression chain.

[0053] Figure 32 is an enlarged view showing the load support mounting mechanism engaged with the compression chain.

[0054] Figure 33 is an elevation view of the motor and drive shafts of the present invention.

[0055] Figures 34 and 35 depict the inner link assembly of the compression chain, with Figure 34 being a plan view and Figure 35 being an elevation view.

[0056] Figures 36 and 37 depict the outer link assembly of the compression chain, with Figure 36 being a plan view and Figure 37 being an elevation view.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0057] Referring now to Figs. 1 and 2, a vertical conveyor **10** according to a presently preferred embodiment is depicted. The conveyor **10** has a skeletal frame **12**. A compression chain vertical conveyor system **14** (Figs. 1 and 30) includes a left subsystem **14a** and a substantially identical right subsystem **14b**. A plurality of platform cells or pans **16** are hung from the conveyor system **14** and are rotated in either direction in an endless racetrack (looped) path (Figures 1, 2 and 30).

[0058] The illustrated conveyor **10** has fourteen pans **16**. Each pan **16** is designed to carry a static load of up to 2268 kg (5,000 pounds), pan thus can carry a full size manufactured automobile. In this illustrated embodiment, the conveyor **10** has an overall height of about 16 m (52 feet), an overall width of about 6 m (20 feet), and an overall length of about 7,6 m (25 feet). The conveyor **10** can be designed to have more than thirty pans **16** and have a height of about 32 m (103 feet). The zoning laws in a particular location where the conveyor is installed will sometimes dictate height requirements.

[0059] Frame **12** (Figs. 1 and 2), is a fixed support structure and is substantially transversely symmetrical about a central plane **18** as depicted in Fig. 2 and is substantially longitudinally symmetrical about a central plane **20**. A top guide strut brace **52** is at the top. As shown in Figs. 2 and 20, the frame **12** includes a front vertical frame section **22** (shown in substantial elevation in Fig. 1) and a substantially identical rear vertical frame section **24** mounted on a rectangular base section **26.** The base section **26** has two transverse headers: 1) a front transverse header **28** and 2) a rear transverse header **30** connected at substantially similar top cornices **32** to two longitudinal side headers (not shown). The front, rear and side headers define an annular rectangle. The base section **26** also includes four legs (three shown) located at and connected to each cornice **32.**

[0060] As shown in Fig. 2, the front header **28** has a rotated "G" shaped cross-section and rests above the automobile entrance. The "G" shaped cross-section forms a stronger, lighter and more economically manufactured member which can be easily installed and removed. In addition, other conveyor equipment can be mounted inside the G-shaped header frame including operating equipment for a gate (not shown) used to block the entrance to the conveyor **10.**

[0061] As shown in Fig. 2, a plurality of internal braces on each side of the vertical conveyor **10** connect the frame sections **22** and **24** together and provide structural rigidity, equalizing the loading between the frame sections. The internal bracing includes horizontal struts **34, 54, 56, 58** (Fig. 2), each of which is rigidly mounted at respective ends to frame sections **22** and **24**. Lateral stability is provided by diagonal bracing **60**, **62** and **64.** The bracing for the top transfer guide **102** Figs. 1, **19** and **20** is shown in section **50** and includes a top guide strut brace **52**, two top guide spacing struts **51** and **57**, and four top guide braces **53, 55, 59** and **61** bolted together to form an "X" configuration.

[0062] As shown in Fig. 1, the frame section **22** has substantially the form of an A-frame. The frame section **22** has a base formed by header **28** and legs **38** and **40,** and has an upper section formed by diagonal columns **66** and **68**. The diagonal columns **66** and **68** are bolted at their lower ends to respective cornices **32** of the A-frame base, and are bolted at their upper ends to each other and to a transverse midpoint of front column **70.**

[0063] A substantially similar rear column **70** (Fig. 2) is provided for the frame section **24**. The column **70** includes a lower section **72** and an upper section **74** that are spliced together with bolts at a vertical mid-portion joint **76** (described below). The height of the mid-portion joint **76** above the foundation **11** depends upon the total number of conveyor pans and the overall height of conveyor **10**. The lower column section **72** includes a solid one-piece weldment.

[0064] The columns **70** and **70'** form a fixed tower structure and provide a conveyor housing and a track **77** for a secondary conveyor assembly that includes a rolling compression chain **78** (Figs. 16 and 17).

[0065] Further non-essential details of the compression chain **78** are described below. Other details of the compression chain **78** and of columns **70** and **70'** can be obtained by referring to United States Patent Nos.

3,424,321, 3,547,281, and 3,656,608 to Lichti.

[0066] Each column **70** and **70'** serves as part of a main frame extending upwardly from the front header **28** (or the rear header for rear frame section **24**) through a joint adjacent the top of conveyor **10** where it supports the upper end of endless compression chain **78** located at the point where chain **78** crosses over from one side to the other.

[0067] Each platform pan **16** has a slightly, upwardly curved, rectangularly configured bottom plate **80.** The bottom plate **80** is supported at each corner by a vertical pan hanger or post **83.** Those posts **83** are located on the same side of the bottom plate **80** and connected at the tops thereof to a horizontal, V-shaped top pan header **84** (Fig. 16). A horizontal, tubular top strut **85** connects the apices of each header **84** and, with two braces **86**, are welded thereto.

[0068] Referring to Figure 16, each platform pan **16** is mounted and stabilized during its travel around conveyor **10** through a mounting assembly **87**. A stub shaft **88** connects the mounting assembly **87** to the pan **16.** The stub shaft **88** extends outwardly from the other side of the apex of each header **84** and is welded thereto. A bearing housing **89** is mounted on the stub shaft **83.** The apex of a "v" shaped link hanger **90** (Figure 32) is pivotally mounted to the bearing housing **89**. The link hanger **90** has two mounting coplanar arms (arm **92** shown in Fig. 16, 30 and 32), which are pivotally mounted at their respective free ends to a compression link of the endless compression chain **78**. As shown in greater detail in Figure 32, a bracket arm **78a** extends from the compression chain **78**. The bracket arm **78g** slides within a respective arm **92** and is held thereto by a clevis pin **93** and cotter pin **93a.**

[0069] Thus, a pan **16** is cantilever mounted at each end to the corresponding conveyor subsystem **14a** and **14b** by a link hanger **90**.

[0070] As shown in Figs. 1, 16 and 32, the apex of a V-shaped stabilizer **96** is also mounted to the stub shaft **88**. The stabilizer **96** pivotally mounts guide shoes **98.** The stabilizer **98** stabilizes the pan **16** as it is conveyed around the top and bottom of the conveyor **10**. Mounted to the top and bottom of front and rear conveyor housing **70** and **72** are a top guide **102** and a bottom guide **104** which contain crossing channels **100** and **102** (see also Fig. 21). Guide shoes **98** of each pan **16** are received in the channels **100** and **101** as a pan **16** is conveyed.

[0071] In general, the vertical conveyor **10** includes a motor means **120**, a pickup drive chain assembly **122** rotated by the motor, and a compression drive chain assembly **124,** driven by the pickup drive assembly **122.** The compression chain assembly **124** includes a compression chain **78** that carries pans **16.**

[0072] In the present invention and as shown in greater detail of Figure 33, the motor means includes a motor **130** which is a double ended, reversible, three phase 460 AC volt input, 500 volt DC output, regenerative electric motor. The motor is connected to the primary drive chain assembly **122** or each frame section **22** and **24** through drive subassemblies **146** and **148** (Fig. 2). Each drive subassembly **146** and 148 comprises a commercially available universal joint **150** which connects a drive shaft **152** to motor **130**. A second, distal universal joint **154** is connected to the distal end of the drive shaft **152.** Connected to the other end of the distal universal joint, through a keyed fitting (not shown) is a conventional, hydraulically actuated electrically operated friction brake **156,** which is connected and mounted to a speed reduction gearing **158** with a splice fitting (not shown). The housing containing the reduction gearing **158** is mounted at the other end to the corresponding vertical frame section **22** or **24**. The reduction gearing **158** is operatively connected to and drives the pickup drive chain assembly **122**. A hydraulic controller, indicated generally at **159a**, actuates the brake **156.** The controller **159a** includes a motor **159b** for driving a pump **159c** for pumping hydraulic fluid from the reservoir **159d.** An accumulator **159e**, pressure switch **159f** and valve **159g** are also included.

[0073] Referring now to Figs. 1 through 6, each pickup drive chain assembly **122** is mounted on a solid, one piece weldment **160** which includes a lower frame section **72** of the frame portion **22.** More particularly, the pickup drive chain assembly **122** is mounted inside an interior cavity **162** of the weldment **160**.

[0074] The pickup drive chain assembly **122** (Figs. 3, 13 and 31) includes an upper toothed drive sprocket subassembly **166** (Fig. 8), a lower toothed idler sprocket subassembly **168** (Fig. 10), a dual drive chain subassembly **170** (Fig. 14) and five pickups arms (pickups) **172** (Fig. 12) attached to the drive chain subassembly **170** with a through-pin **194** (Fig. 14) and rotated in a racetrack path. In the illustrated embodiment, there are only five pickups **172.** For explanation and clarity, one of the pickups **172** is shown in phantom (Fig. 3) in an advanced position at the top of drive chain subassembly **170**. In Figure 4 the bottom-most pickup **172** has been omitted.

[0075] An upper toothed drive sprocket subassembly **166** is an integral, one-piece, molded element (Figs. 7 and 8) and includes an outside drive sprocket **176**, a substantially similar inside drive sprocket **178**, and an interconnecting, hollow tube **179.** A solid shaft **180** (Fig. 6) is keyed to and mounted inside the tube **179** and terminates on its inner end in a splice (not shown), which in turn is mounted to and driven by reduction gearing **158.** The outer end of the shaft **180** is mounted in a bearing **183** (Fig. 6), which in turn is rigidly mounted to the weldment **160.** Each drive sprocket **176** and **178** has a mean diameter of about 23 inches, a total of 18 standard teeth **181**, and two sets of two reduced diameter teeth **181'** located **180** degrees apart. The teeth **181'** terminate inside the mean diameter circle **177**. The radial size of the teeth is smaller so as to provide clearance for the diameter of the through-pin **194**.

[0076] The lower toothed idler sprocket subassembly

168 is shown in Figs. 4, 6, 9, 10, and 15 and includes an outside idler sprocket **184**, a substantially similar inside idler sprocket (not shown), and coaxial, spaced apart shaft **188** for respectively mounting inside and outside idler sprockets. The **186** spacing between the adjacent ends of shafts **188** is selected so that pickups **172** can pass therebetween. Idler sprocket **184** has a diameter of about 0,31 m (12 1/4 inches) and a total of nine teeth **185** and two teeth **185'**. The teeth **185'** terminate inside the mean diameter circle **187** and the pitch between them is deeper so as to provide clearance for the larger diameter of the through-pin **194.**

[0077] The pickup drive chain subassembly **122** (Figs. 13 and 14) is comprised of a first roller chain **190** and a second roller chain **192** each with five interconnected, matched strands. The center lines of the roller chains **190** and **192** are spaced apart about 0,22 m (8 1/2 inches) and the two chains are interconnected with five through-pins **194.** Each of the five strands of each chain **190** and **192** is about 0,87 m (34 1/4 inches) long and terminates in a master link **195** which connects to the adjacent strand and which mounts through-pin **194.** In this particular embodiment, each chain **190** and **192** has an average tensile strength of 68039 kg (150,000 pounds) per strand. The center axis line of the through-pins **194** is offset from a center line drawn from chain link-pins **197** (Fig. 13).

[0078] As shown in Figs. 3, 4, 11, 13 and 14 a pickup **172** is pivotally mounted at the bottom section thereof on each heat-treated through-pin **194**.

[0079] The pickups **172** of the present invention have a split body. Each pickup **172** includes an upper head portion **196** and a smaller, lower bifurcated tail portion **198** that is mounted to upper head portion with bolts and nuts (not shown). In a preferred embodiment, pickup **172** is almost 0,66 m (26 inches) long and a little over 0,36 m (14 inches) wide at the top and tapers down to 17,78 cm (7 inches) wide at the bottom of head portion **196** with a 25,4 cm (10 inch) radius curve. Each pickup **172** is journalled onto the through-pin **194** and is held centered thereon with snap rings **199** on either side. A notch **200** (Fig. 12) on each side of the centerline of pickup **172** in the upper head portion **196** engages with and picks up a connecting pin assembly, shown at **210** (Fig 3), in compression chain **78** (Fig. 16).

[0080] The mating ends of the head portion **196** and tail portion are provided with mating half-circular cutouts. The cutout in the head portion **196** has a nominal radius of 3,8 cm (1.5 inches) so it can receive a semi-circular bearing insert **201** having integral end flanges. The cutout in the tail portion **198** has a nominal radius of 3,2 cm (1.25 inches), which matches with the inner surface of insert **201**. A sleeve **202** has a thickened central portion with a central circular slot therein for engaging the head portion. The sleeve **202** has a reduced shoulder to support ball bearings **203** at each end. Each ball bearing supports **203** a metal wheel **204**, which has been heat treated to a surface hardness of Rc 44/47. The wheels **203** have an outer diameter of 11,75 cm (4.625 inches) in a preferred embodiment and engage and ride on a bottom guard **205** (see Fig. 4), which helps orient the pickup **172**.

[0081] Located near the top of head portion **196** (Fig. 12) is a hole having a radius of 4,45 cm (1 3/4 inches) for mounting a upper shaft **206.** Mounted onto each end of shaft **206** (Fig. 11) are ball bearings **207** which in turn mount a top, inner flanged wheel **208**, which has an base outer diameter of 11,4 cm (4.5 inches) and a flange outer diameter of 13,3 cm (5.25 inches) in a preferred embodiment. Wheel **208** engages and is guided by a plurality of track guides **209** (Fig. 4) and **352** (Fig. 4). Mounted between upper wheel **208** and lower wheel **204** on either side of pickup **172** is a somewhat triangular safety lug **211** (Fig. 12) which restricts the back fall of the pickup traversing the top guide **350** (Fig. 4).

[0082] As shown in Figs. 3, 16 and 34 through 37, the compression chain **78** includes a plurality of outer compression links **212** and a plurality of inner compression links **214**, which are similar to and fit inside outer compression links **212**. The inner and outer compression links are pivotally interconnected by connecting pin assemblies **210.** Also mounted to the inner link **214** are two angled connecting lugs **228,** only one of which is depicted in Fig. 16, for connecting link hanger arms **91** and **92** of the pan **16.**

[0083] As shown in Fig. 3, the bearing roller **238** is engaged in one of the notches **200** of the pickups **172** as the engaging pickup **172** lifts or pushes it and the associated compression link upwards. Thus the weight of the whole load on the side of the upwardly rotated conveyor **10** is realized through bearing roller **238.** The compression chain also includes two roller **292, 294** which fit within the formed channels **77** so that the compression chain forms a roller chain with reduced friction as it moves in a looped manner.

[0084] The guide and channel subassemblies for the compression chain assembly **124** (Fig. 2) are integral components with the other elements of the conveyor **10**. For the upper frame section **74** (Figs. 1 and 17), the outwardmost components have spaced apart left hand guide rails **252** and right hand guide rails **254** (Fig. 17). The guide rails **252** include an inner guide channel **256** and an outer guide channel **258** spaced apart to the plate **260.** The guide rails **254** are formed of an inner guide channel **262** and an outer channel **264** spaced apart to a plate **266.** Each guide channel also serves as a vertical structural component and has a bevelled U-shaped channel that is welded to the upper frame section **74.** The compression chain rollers **292, 294** (Fig. 16) have a similar size, shape and bevel to the slope of the guide channels. The upper and lower ends of channels **252** and **254** are flared inwardly to permit the compression links **214** to "bend over" the top of frame sections **74** (Fig. 1) and **74a** (Fig. 2).

[0085] The guide and channel subassemblies for the lower tower section are parts of the weldment **160**

(shown in Figs. 3, 4, 6 and 18). As shown in Fig. 18, the weldment **160** is formed of a welded metal sheet base plate **270** having side plates **272** and **274** welded to each end to form a somewhat rectangular box. In the middle section of side plates **272** and **274** are slots **276** and **278** to accommodate pickups **172** entering the channel area and engaging connecting pin **210** of compression chain **78**. The weldment, **160**, as shown in Fig. 18, also contains suitable mounting plates, such as mounting plate **280,** for mounting the pickup dive chain assembly **122.**

[0086] Directly welded to side plate **272** is a guide rail **282.** A guide rail **284** is welded to side plate **274**. The guide rail **282** has an inner guide channel **286** (Fig. 18) and an outer guide channel **288** spaced apart and connected to side plate **274** by welding. Similarly, the guide rail **284** has an inner guide channel **290** and an outer channel **290** mounted spaced apart and connected to side plate **274** by welding. Each guide channel **286**, **288, 290** and **292** also serves as vertical structural component and is a bevelled U-shaped channel that is connected to weldment **160.** Also, each U-shaped channel has the same size and shape as channels **256, 258, 262** and **264.**

[0087] The weldment **160** (Figs. 3, 4 and 6) has three pickup guides - the bottom guide **205**, side guide **209**, and a top guide **302.** The bottom guide **205** is also shown in Fig. 15 and has a mounting plate **304** rigidly attached at the bottom to a square mounting tube **306.** Two substantially identical spaced guides **308** and **309** (not shown) are rigidly mounted at their respective bottoms to the mounting tube **306**. Each guide **308** and **309** is comprised of a U-shaped guide plate **310** (Fig. 4) with removably mounted tip portions **312** bolted thereto and supporting side gusset plates **314**. A flat polyurethane guide bar **316** is mounted perpendicularly along the inner edge of guide plate **310** (Fig. 4). The pivot pin **320** also catches the tail portion of the pickup **172** as the pickup **172** is rotated in either direction to it. This holds the bottom of the pickup **172** stationary, and permits the top portion, connected to chains **190** and **192**, to be rotated with respect to the bottom in the proper direction.

[0088] The side guides **209** have an outer guide plate **326** which extends out of the paper (Fig. 3) and an inner guide plate **328** which is bolted to the primary drive mounting plate **272** and **274** (Fig. 18).

[0089] The top guide **302** (Fig. 3) has a front upper guide plate **340** rigidly mounted on the weldment **160** and a lower guide plate **342** spaced below the upper guide plate **340.** A similarly shaped rear upper guide (not shown) is spaced 6,4 cm (2½ inches) behind the front guide. Together the front and rear guides form a captive path **352** for the upper wheel **208** of a pickup **196** to traverse the top of the drive. A plurality of U-shaped jointing plates **344** are perpendicular to the plates **340** and **342** and welded at its respective feet to plates **340** and **342.** As seen in Fig. 5, the upper guide plate **340** has a lower concave curvilinear surface **346** with a circular upper mid-portion cutout **348** which is symmetrical about the centerline. The curvilinear surface **346** has a preferred lower circular segment with a 12,1 cm (4.75 inch) radius and an upper circular segment with a 1 m (39.75 inch) radius. The cutout **348** has a 5,7 cm (2.25 inch) radius. The bottom length of upper guide plate is 69,9 cm (27.5 inches). The lower guide plate **346** has a pentagon shape with an upper convex curvilinear surface **350** that is symmetrical about the centerline. Each half of surface **350** has a circular segment to produce a guide path **352** (Fig. 4).

[0090] As upper wheel **208** of pickup **172** enters either end of guide path **352**, it will cause pickup **172** to rotate slightly in the direction of motion. When pickup upper wheel **288** enters cutout **348,** the top of pickup **172** is prevented from rotating and the pickup tail will then rotate in the direction through the center of the drive. In this way, pickup **172** is rotated into preferred orientation to exit the top guide path.

[0091] Referring now to Figures 26, 27 and 28, details of the dampening action imparted to the apparatus is described together with an improved locking device.

[0092] As a pan **16** (Fig. 1) traverses the top of the conveyor **10,** the shoes **98** (Fig. 1) are engaged in the tracks **100** and **101** (Fig. 21) of the top transfer guide **102** (Fig. 1) and lift the transfer guide upward at the apex of the travel and then returns as the shoes pass from the apex of travel. The top transfer guide **102** (Fig. 19) is comprised of the sliding guide support **107** and transfer guide **108.** The center tube **109** of the sliding guide **107** is bolted **111** to the fixed tower **22**. In Fig. 26 the vertical weight of the transfer is counter balanced by the four shock absorbers **113** which also provide a dampening motion for the guide movement. Inside the center tube **109** is a ground tube **114** (Fig. 27) that provides a vertical guide for the sliding guide **107.** At the bottom end of the round tube **114** is round bar that engages a friction bar **115** and is restrained by a captive bar **116.** Bellville washers **117** provide friction between a friction plate **118** and the captive bar **116**. The friction connection is then established between the fixed tower **22** and the sliding guide **107** and still allow a downward movement of the transfer guide as the compression chain shortens during the life of the conveyor.

[0093] The bottom transfer guide **130** floats down and up as a pan **16** (Fig. 1) traverses the bottom of the conveyor **10** (Fig. 1). The vertical weight of the bottom transfer guide **130** is transferred through the two shock absorbers **131** (Fig. 22) and two die springs **132** (Fig. 22) to the header **28**. The shock absorbers **131** provide the dampening of the vertical motion of the bottom transfer guide **130**. The upward motion of the guide **130** is restricted by die spring **133** and is mounted such that it comes in contact with the under side of header **28** (Fig. 1) during excessive upward movements. This series of die springs and shock absorbers keep the bottom transfer guide at a prescribed reference point and still allow vertical motion with a dampening effect.

[0094] When a pan **16** (Fig. 1) is at the bottom of the

conveyor **10** the lock link system **140** (Fig. 4 and 25) is in its extended position. The height of the lock link bar **141** (Fig. 4) is such that the top of the bar **141** is 1/8 (0.125) of an inch below a bearing roller **238** (Fig. 3) of a compression link. Normally a service brake **156** (Fig. 2) provides the holding power to resist any unbalanced load. If one or both of these brakes **156** fail then the compression chain **78** could move in the direction of the unbalanced load. The lock link bars **141** are extended and retracted by the cam motion of the actuator **143** (Fig. 25). In Fig. 25 the lock link bars **141** are shown extended to engage the compression chain. When the bar **141** is rotated clockwise **180** degrees, the lock link bar will retract and allow the compression chain **78** to move.

Claims

1. A vertical conveyor comprising:

a frame (12) having a first vertical frame section (22) and a second vertical frame section (24) spaced apart, but supportingly connected thereto,

a plurality of load supports (16), each support (16) having a first and second end capable of holding a load to be conveyed around in a looped path, each support (16) being movably mounted at the first and second ends respectively to the first and second frame section (12, 22) such that as one support (16) is being conveyed upwardly, while another support (16) is being conveyed downwardly so that the supports (16) pass one another at a predetermined spaced apart horizontal distance which defines the support spacing,

first and second conveying means (122, 124) mounted respectively to said first and second frame sections (22, 24) for respectively conveying a first and second end of said supports (16), said first and second conveying means (122, 124) each comprising a looped compression chain (78) supporting said supports,

a pick-up of drive chain (170) comprising at least two strands (190, 191) and through pins (194) interconnecting the matched strands,

a plurality of pick-up arms (172) pivotally connected to said through pins (194) such that said pick-up arms (172) engage and drive said compression chain (78), and

motor means (120) for simultaneously driving said first and second pick-up drive chains (190, 191) so that said pick-up arms (172) engage and drive said compression chain (78) so as to move said load supports (16),

characterised in that

said pick-up arms (172) comprise a two-piece journal construction having an upper head portion (196) and lower tail portion (198), each portion having cut outs at mating ends to form an opening through which a respective through pin (194) is received, said upper head portion (196) and lower tail portion (198) being removably mated to each other so as to enable ready disassembly of the pick-up arms (172) from the pick-up drive chain (170).

2. The vertical conveyor according to claim 1 wherein said first and second conveying means (122, 124) comprises a compression chain assembly (124) which supports said load supports (16), and a plurality of pickup arms (172) pivotally connected to said pickup drive chain (122) such that said pickup arms (172) engage and drive said compression chain (124) so as to move said load supports (16).

3. The vertical conveyor according to claim 2 wherein said pickups (172) are pivotally mounted offset on said pickup drive chain (122) to aid in engagement of said pickups (172) with said compression chain (124).

4. The vertical conveyor according to claim 2 or 3 wherein said compression chain assembly includes an endless roller chain comprised of interconnecting, elongate compression links (214, 212) and transverse axles (210) mounted at each end of said compression links (212, 214) such that said pickup arms (172) engage said axles (210) for pushing said compression links (212, 214) upward.

5. The vertical conveyor according to claim 4 wherein said load supports (16) include load support mounting arms, and means pivotally mounting said load support mounting arms to said compression links (212, 214).

6. The vertical conveyor according to claim 1 including a mounting member extending in said support spacing, wherein said motor means (120) is mounted to said mounting member, and including a connecting member supportingly connecting said first and second frame sections (122, 124), and wherein said motor mounting member is suspended from said one connecting member substantially centrally between said frame members (22, 24).

7. The conveyor according to one of the claims 1 to 6 wherein the pickup drive chain (170) comprises two

spaced roller chains (190, 191), each through-pin (194) interconnecting said roller chains, wherein said pickups (172) are pivotally connected to said roller chains between said pickups (172).

8. The conveyor according to one of the claims 1 to 7 wherein said pickup drive chain (170) includes a link, and a link pin (172) interconnecting said links, and wherein said through-pins (194) are offset from said link pins (197).

9. The conveyor according to one of the claims 1 to 8 wherein said pickups comprise the upper head portion and the smaller, lower bifurcated tail portion.

10. The conveyor according to one of the claims 1 to 9 wherein the upper head portion (196) includes two receiving notches (200) for receiving therein respective through-pins on said compression chain (124).

Patentansprüche

1. Senkrechtförderer, der umfaßt:

ein Gestell (12) mit einem ersten vertikalen Gestellabschnitt (22) und einem zweiten vertikalen Gestellabschnitt (24), der von diesem beabstandet, jedoch tragend damit verbunden ist,

eine Vielzahl von Lastauflagen (16), wobei jede Auflage (16) ein erstes und ein zweites Ende aufweist, das eine Last aufnehmen kann, die um einen Endlosweg befördert wird, jede Auflage (16) an dem ersten und dem zweiten Ende beweglich so an dem ersten bzw. dem zweiten Gestellabschnitt (12, 22) angebracht ist, daß, während eine Auflage (16) nach oben befördert wird, eine andere Auflage (16) nach unten befördert wird, so daß die Auflagen (16) einander um eine vorgegebene horizontale Strecke beabstandet passieren, die den Auflagenabstand bildet,

eine erste und eine zweite Fördereinrichtung (122, 124), die an an dem ersten bzw. dem zweiten Gestellabschnitt (22, 24) angebracht sind, um jeweils ein erstes bzw. zweites Ende der Auflagen (16) zu befördern, wobei die erste und die zweite Fördereinrichtung (122, 124), jeweils eine Endlos-Druckkette (78) umfassen, die die Auflagen trägt,

eine Mitnehmer-Antriebskette (170), die wenigstens zwei Stränge (190, 191) und Durchgangsstifte (194) umfaßt, die die aufeinander abgestimmten Stränge miteinander verbinden,

eine Vielzahl von Mitnehmerarmen (172), die schwenkbar mit den Durchgangsstiften (194) so verbunden sind, daß die Mitnehmerarme (172) mit der Druckkette (78) in Eingriff sind und sie antreiben, und

eine Motoreinrichtung (120), die gleichzeitig die erste und die zweite Mitnehmer-Antriebskette (190, 191) antreibt, so daß die Mitnehmerarme (172) mit der Druckkette (78) in Eingriff kommen und sie antreiben, um die Lastauflagen (16) zu bewegen,

dadurch gekennzeichnet, daß:

die Mitnehmerarme (172) eine aus zwei Teilen bestehende Lagerkonstruktion mit einem oberen Kopfabschnitt (196) und einem unteren Schwanzabschnitt (198) umfassen, wobei jeder Abschnitt Ausschnitte an ineinandergreifenden Enden aufweist, so daß eine Öffnung entsteht, in der ein entsprechender Durchgangsstift (194) aufgenommen wird, wobei der obere Kopfabschnitt (196) und der untere Schwanzabschnitt (198) lösbar miteinander verbunden sind, um schnelle Demontage der Mitnehmerarme (172) von der Mitnehmer-Antriebskette zu ermöglichen.

2. Senkrechtförderer nach Anspruch 1, wobei die erste und die zweite Fördereinrichtung (122/124) eine Druckketten-Baugruppe (124) umfassen, die die Lastauflagen (16) trägt, sowie eine Vielzahl von Mitnehmerarmen (172), die schwenkbar an der Mitnehmer-Antriebskette (122) so angebracht sind, daß die Mitnehmerarme mit der Druckkette (124) in Eingriff kommen und sie antreiben, um die Lastauflagen zu bewegen.

3. Senkrechtförderer nach Anspruch 2, wobei die Mitnehmer (172) schwenkbar versetzt an der Mitnehmer-Antriebskette (122) angebracht sind, um den Eingriff der Mitnehmer (172) mit der Druckkette (124) zu erleichtern.

4. Senkrechtförderer nach Anspruch 2 oder 3, wobei die Druckketten-Baugruppe eine Endlos-Rollenkette enthält, die aus miteinander verbundenen, länglichen Druckgliedern (214, 212) und Querachsen (210) besteht, die an jedem Ende der Druckglieder (212, 214) so angebracht sind, daß die Mitnehmerarme (172) mit den Achsen (210) in Eingriff kommen und die Druckglieder (212, 214) nach oben schieben.

5. Senkrechtförderer nach Anspruch 4, wobei die Lastauflagen (16) Lastauflagen-Anbringungsarme sowie Einrichtungen umfassen, mit der die Lastauf-

lagen-Anbringungsarme schwenkbar an den Druckgliedern (212, 214) angebracht sind.

6. Senkrechtförderer nach Anspruch 1, der ein Anbringungselement enthält, das sich in dem Auflagenzwischenraum erstreckt, wobei die Motoreinrichtung (120) an dem Anbringungselement angebracht ist, und der ein Verbindungselement enthält, das den ersten und den zweiten Gestellabschnitt (122, 124), 124) tragend miteinander verbindet, und das Motoranbringungselement an dem Verbindungselement im wesentlichen mittig zwischen den Gestellelementen (22, 24) aufgehängt ist.

7. Förderer nach einem der Ansprüche 1 bis 6, wobei die Mitnehmer-Antriebskette (170) zwei beabstandete Rollenketten (190, 191) umfaßt, jeder Durchgangsstift (194) die Rollen ketten miteinander verbindet, wobei die Mitnehmer (172) zwischen den Mitnehmern (172) schwenkbar mit den Rollenketten verbunden sind.

8. Förderer nach einem der Ansprüche 1 bis 7, wobei die Mitnehmer-Antriebskette (170) ein Glied und einen Gliedstift (172) umfaßt, der die Glieder miteinander verbindet, und wobei die Durchgangsstifte (194) gegenüber den Gliedstiften (197) versetzt ist.

9. Förderer nach einem der Ansprüche 1 bis 8, wobei die Mitnehmer den oberen Kopfabschnitt und den kleineren, unteren gegabelten Schwanzabschnitt umfassen.

10. Förderer nach einem der Ansprüche 1 bis 9, wobei der obere Kopfabschnitt (196) zwei Aufnahmekerben (200) enthält, in denen entsprechende Durchgangsstifte an der Druckkette (124) aufgenommen werden.

Revendications

1. Transporteur vertical comprenant :

un châssis (12) ayant une première section de châssis verticale (22) et une seconde section de châssis verticale (24) espacées l'une de l'autre mais reliées à des fins de support entre elles ;
une pluralité de supports de charge (16), chaque support (16) ayant des première et seconde extrémités aptes à contenir une charge à transporter sur un trajet en boucle, chaque support (16) étant fixé de manière mobile, au niveau des première et seconde extrémités respectivement, aux première et seconde sections de châssis (12, 22) de sorte qu'un support (16) soit transporté vers le haut tandis qu'un autre support (16) est transporté vers le bas, afin que les supports (16) se dépassent mutuellement sur une distance horizontale prédéterminée espacée qui définit l'écartement des supports,
des premiers et seconds moyens de transport (122, 124) fixés respectivement auxdites première et seconde sections de châssis (22, 24) afin de transporter respectivement des première et seconde extrémités desdits supports (16),
lesdits premiers et seconds moyens de transport (122, 124) comprenant chacun une chaîne de compression en boucle (78) supportant lesdits supports,
une chaîne d'entraînement par préhension (170) comprenant au moins deux câbles (190, 191) et des broches traversantes (194) reliant les câbles correspondants,
une pluralité de bras de préhension (172) reliés de manière pivotante auxdites broches traversantes (194) de telle sorte que lesdits bras de préhension (172) viennent en prise avec ladite chaîne de compression (78) et l'entraînent, et
des moyens de moteur (120) permettant d'entraîner simultanément lesdites première et seconde chaînes d'entraînement par préhension (190, 191) de sorte que lesdits bras de préhension (172) viennent en prise avec ladite chaîne de compression (78) et l'entraînent afin de déplacer lesdits supports de charge (16),

caractérisé en ce que

lesdits bras de préhension (172) comprennent une construction de tourillon en deux parties présentant une partie de tête supérieure (196) et une partie de queue inférieure (198), chaque partie présentant des découpes au niveau des extrémités accouplées pour former une ouverture à travers laquelle est reçue une broche traversante respective (194), ladite partie de tète supérieure (196) et ladite partie de queue inférieure (198) étant accouplées de manière amovible l'une à l'autre afin de permettre un démontage facile des bras de préhension (172) depuis la chaîne d'entraînement par préhension (170).

2. Transporteur vertical selon la revendication 1, dans lequel lesdits premiers et seconds moyens de transport (122, 124) comprennent un ensemble de chaîne de compression (124) qui supporte lesdits supports de charge (16) et une pluralité de bras de préhension (172) reliés de manière pivotante à ladite chaîne d'entraînement par préhension (122) de sorte que lesdits bras de préhension (172) viennent en prise avec ladite chaîne de compression (124) et l'entraînent afin de déplacer lesdits supports de charge (16).

3. Transporteur vertical selon la revendication 2, dans lequel lesdits bras de préhension (172) sont fixés de manière pivotante en position décalée sur ladite chaîne d'entraînement par préhension (122) afin de faciliter la mise en prise desdits bras de préhension (172) avec ladite chaîne de compression (124).

4. Transporteur vertical selon la revendication 2 ou 3, dans lequel ledit ensemble de chaîne de compression comprend une chaîne à rouleaux sans fin constituée de chaînons de compression (214, 212) interconnectés, allongés et d'axes transversaux (210) montés à chaque extrémité desdits chaînons de compression (212, 214) de sorte que lesdits bras de préhension (172) viennent en prise avec lesdits axes (210) pour pousser lesdits chaînons de compression (212, 214) vers le haut.

5. Transporteur vertical selon la revendication 4, dans lequel lesdits supports de charge (16) comprennent des bras de fixation de support de charge et des moyens fixant de manière pivotante lesdits bras de fixation de support de charge auxdits chaînons de compression (212, 214).

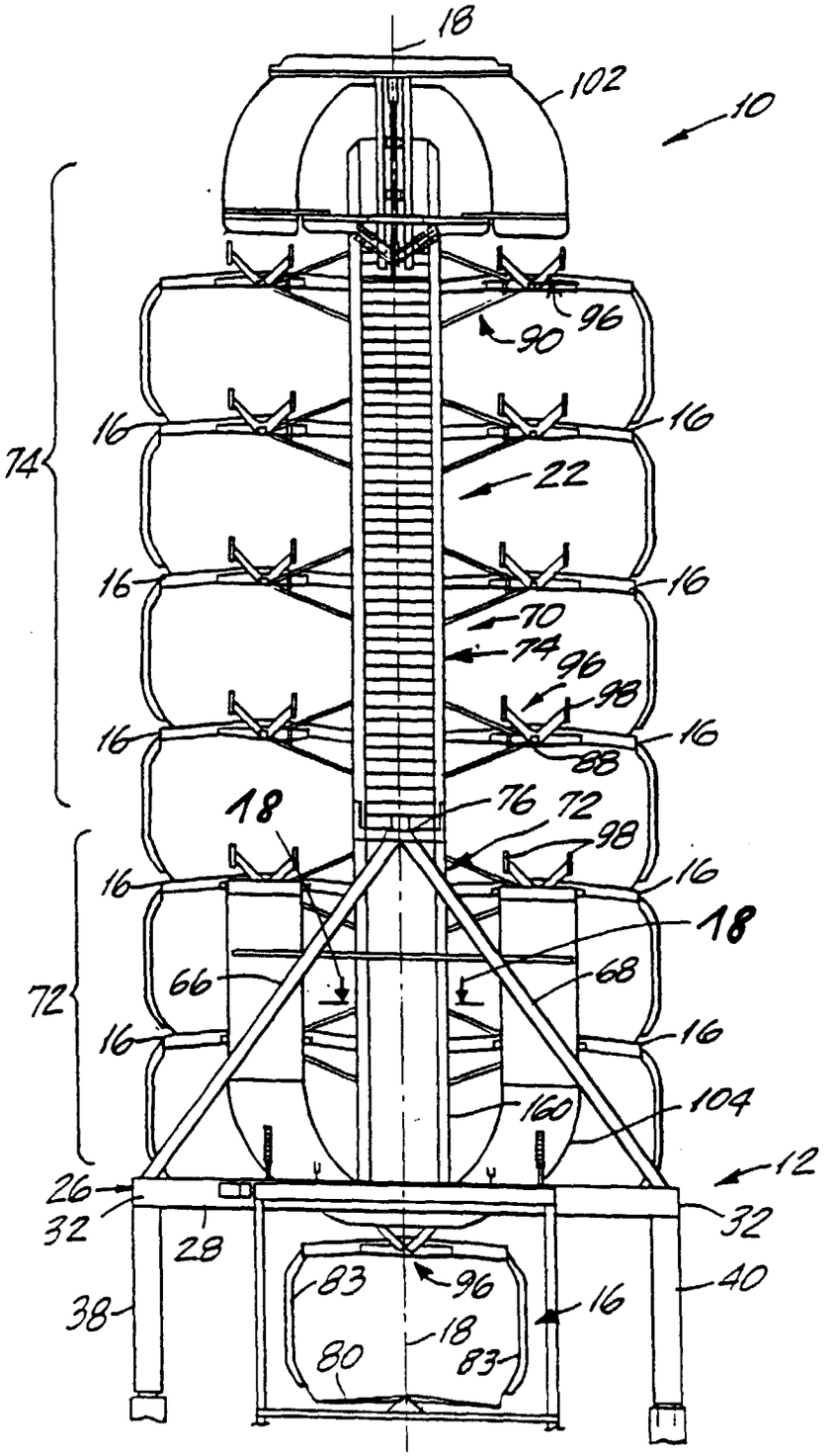
6. Transporteur vertical selon la revendication 1, comprenant un élément de fixation s'étendant dans ledit espacement de support, dans lequel lesdits moyens moteurs (120) sont fixés sur ledit élément de fixation, et comprenant un élément de raccordement reliant à des fins de support lesdites première et seconde sections de châssis (122, 124) et dans lequel ledit élément de fixation du moteur est suspendu audit élément de raccordement en position sensiblement centrale entre lesdits éléments de châssis (22, 24).

7. Transporteur selon l'une des revendications 1 à 6, dans lequel la chaîne d'entraînement par préhension (170) comprend deux chaînes à rouleaux espacées (190, 191), chaque broche traversante (194) reliant lesdites chaînes à rouleaux l'une à l'autre, dans lequel les bras de préhension (172) sont reliés de manière pivotante auxdites chaînes à rouleaux entre lesdits bras de préhension (172).

8. Transporteur selon l'une des revendications 1 à 7, dans lequel ladite chaîne d'entraînement par préhension (170) comprend un chaînon, et une broche à chaînons (172) reliant lesdits chaînons, et dans lequel lesdites broches traversantes (194) sont décalées desdites broches à chaînons (197).

9. Transporteur selon l'une des revendications 1 à 8, dans lequel lesdits bras de préhension comprennent la partie de tête supérieure et la partie de queue plus petite, inférieure, bifurquée.

10. Transporteur selon l'une des revendications 1 à 9, dans lequel la partie de tête supérieure (136) comprend deux encoches de réception (200) destinées à recevoir des broches traversantes respectives sur ladite chaîne de compression (124).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102
10
96
90
16
74
22
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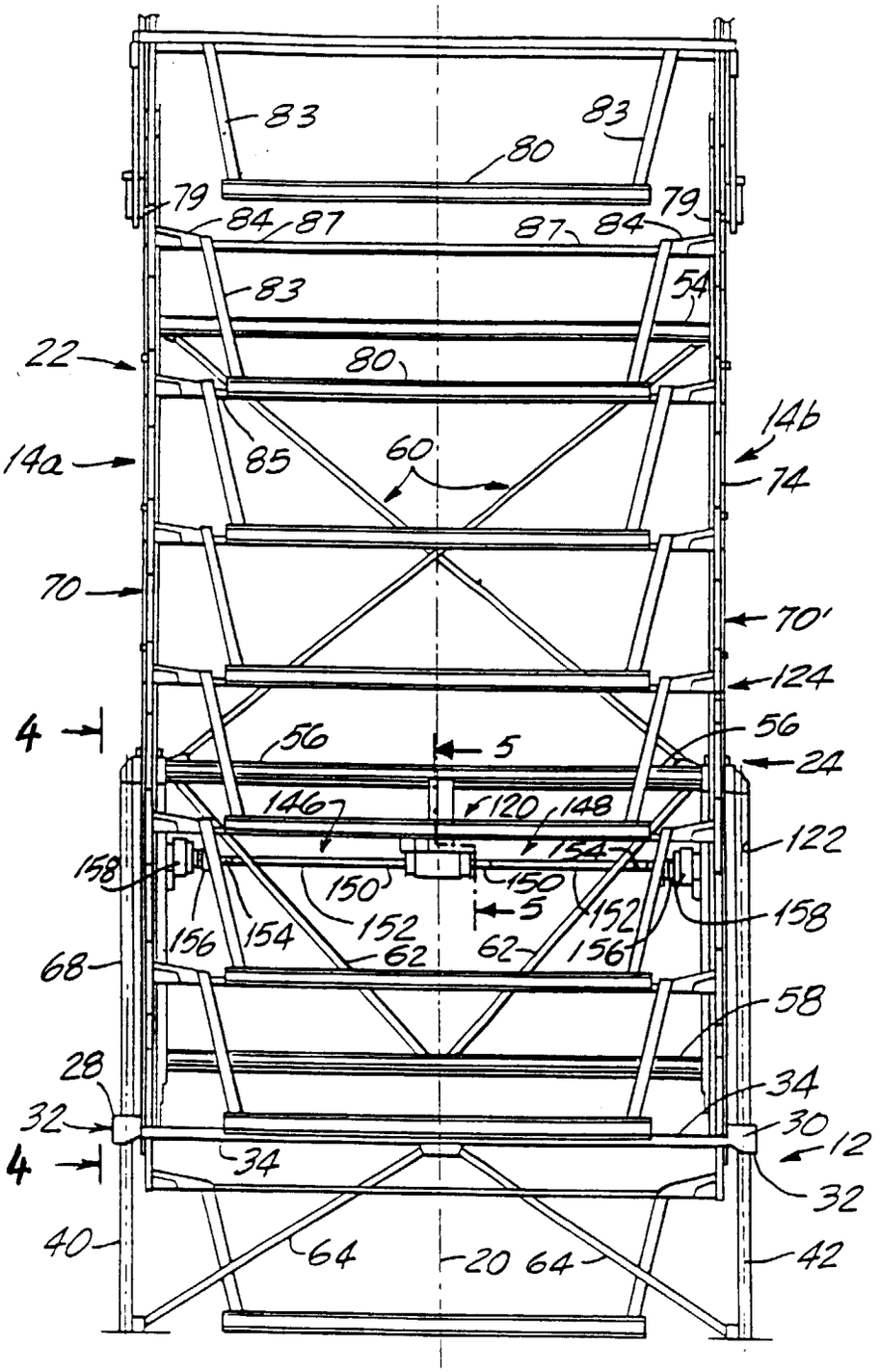
72
66
68
104
160
12
26
32
28
83
80
38
40

FIG. 1


83
83
80
79
84
87
87
84
79
83
54
22
80
14b
14a
85
60
74
70
70'
124
4
56
5
56
24
146
120
148
154
122
158
150
150
5
152
158
156
154
152
62
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40
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20
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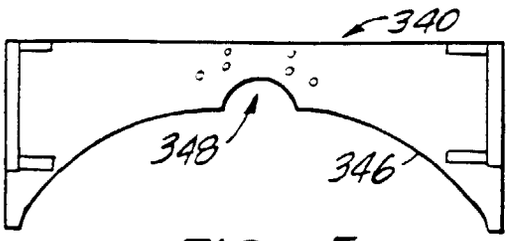
42

FIG. 2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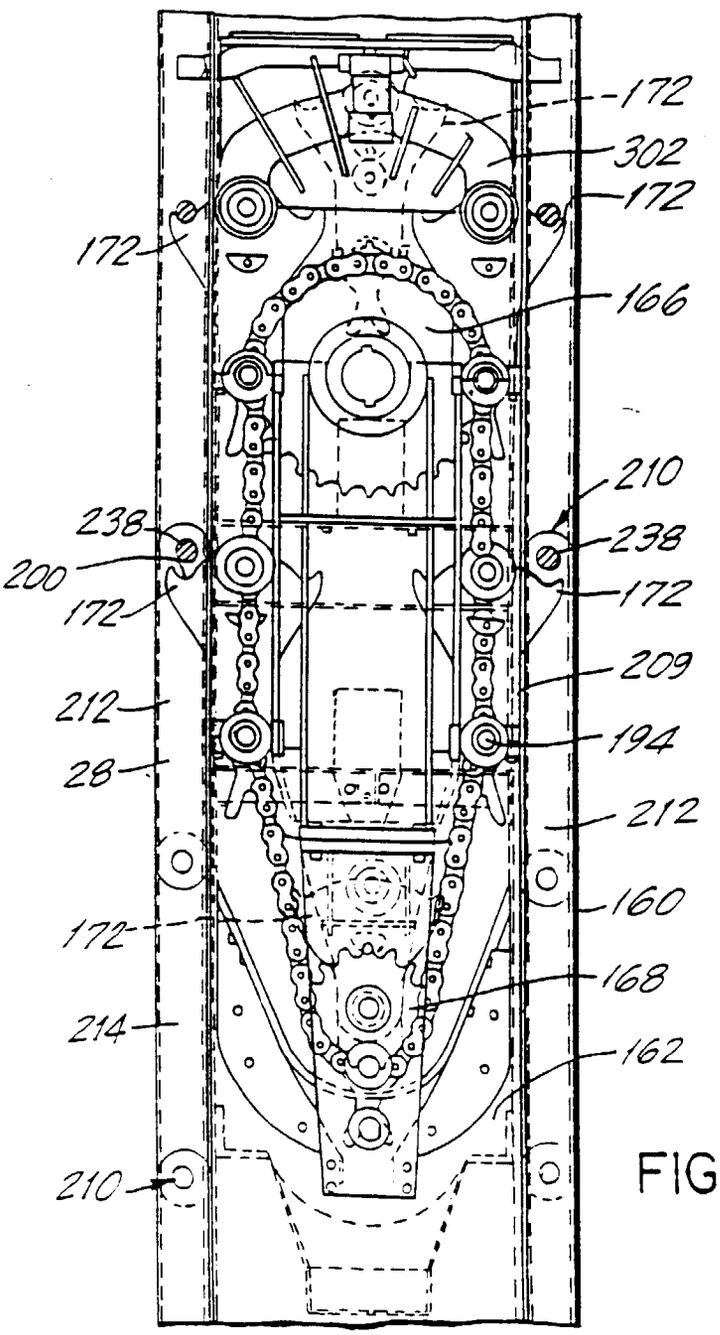
346

FIG. 5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302
172
172
166
210
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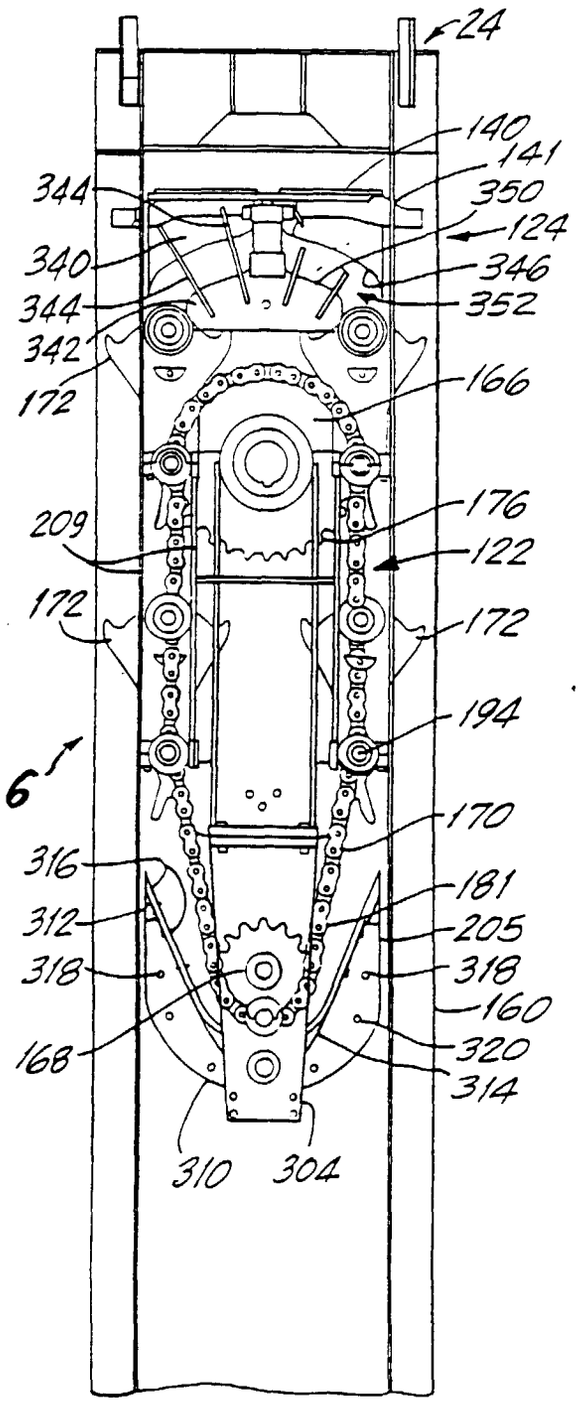
200
172
172
209
212
194
28
212
160
172
168
214
162
210

FIG. 3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124
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346
344
352
342
172
166
176
209
122
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6
170
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181
312
205
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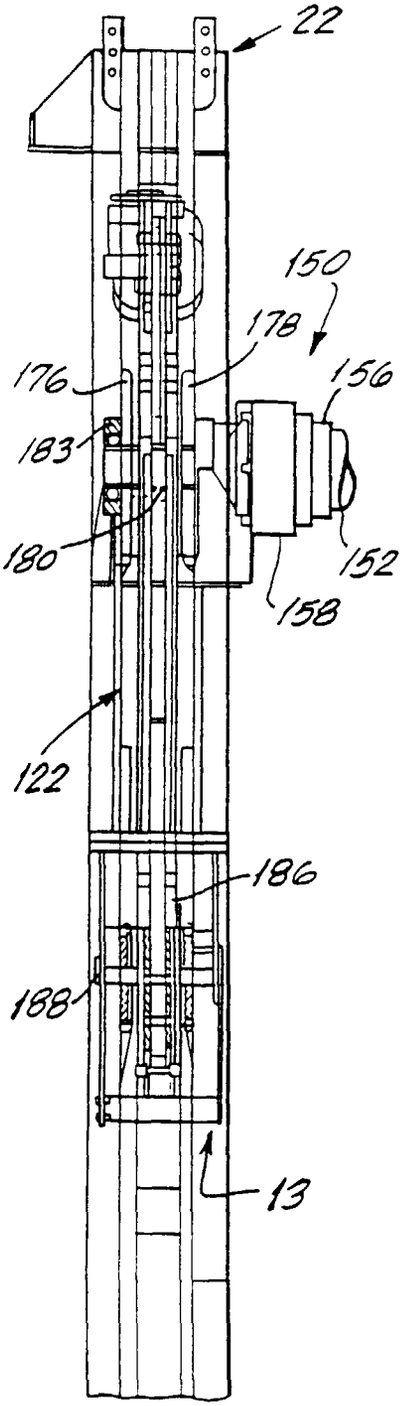
318
160
168
320
314
310
304

FIG. 4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176
156
183
180
152
158
122
186
188
13

FIG. 6

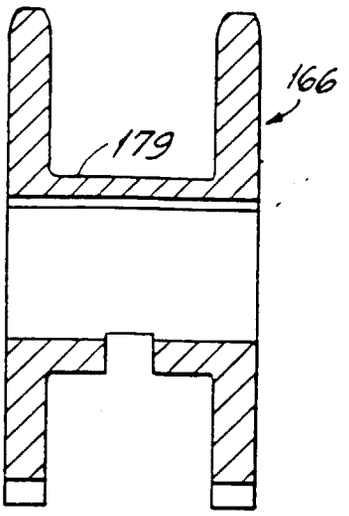

FIG. 8

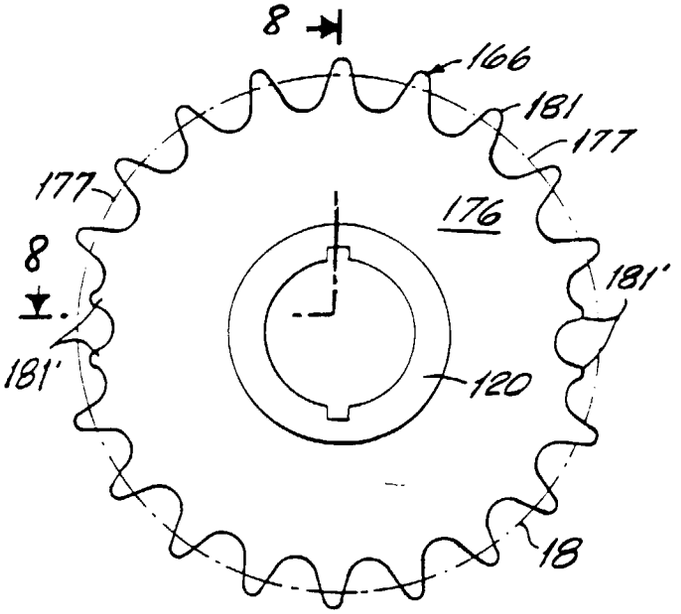

FIG. 7

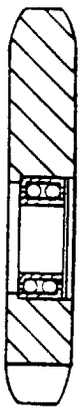

FIG. 10

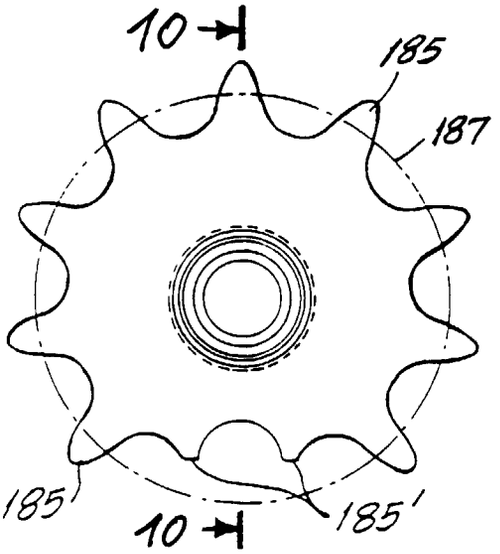

FIG. 9

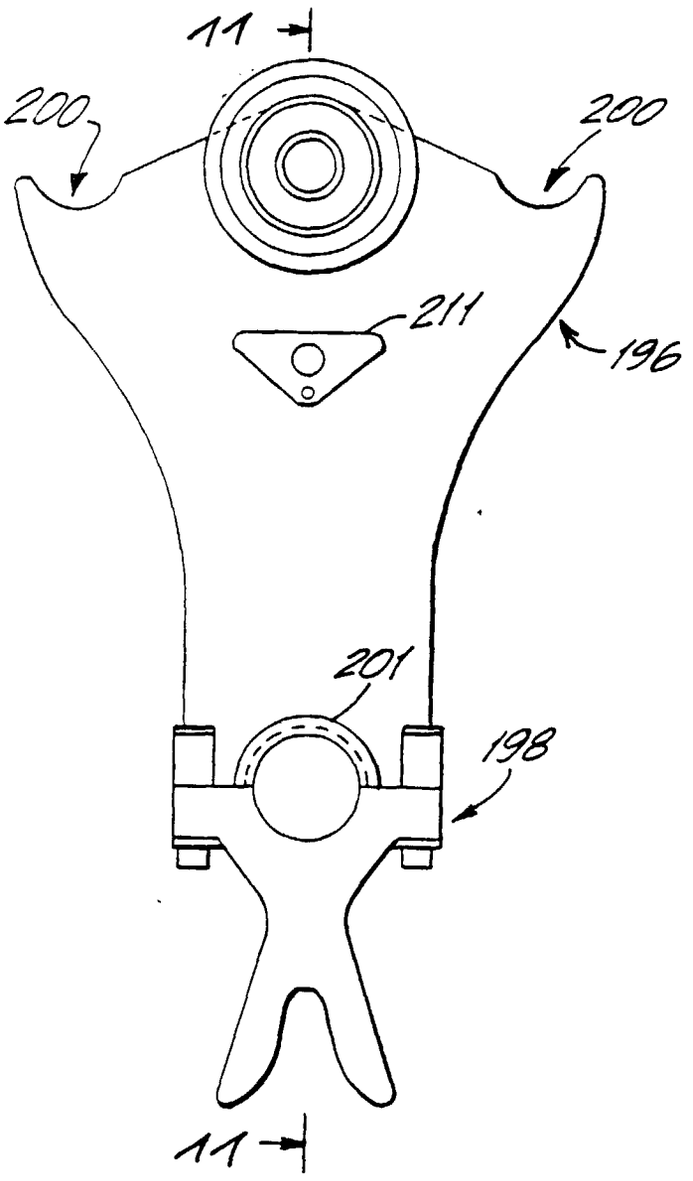
11
200
200
211
196
201
198
11

FIG. 12

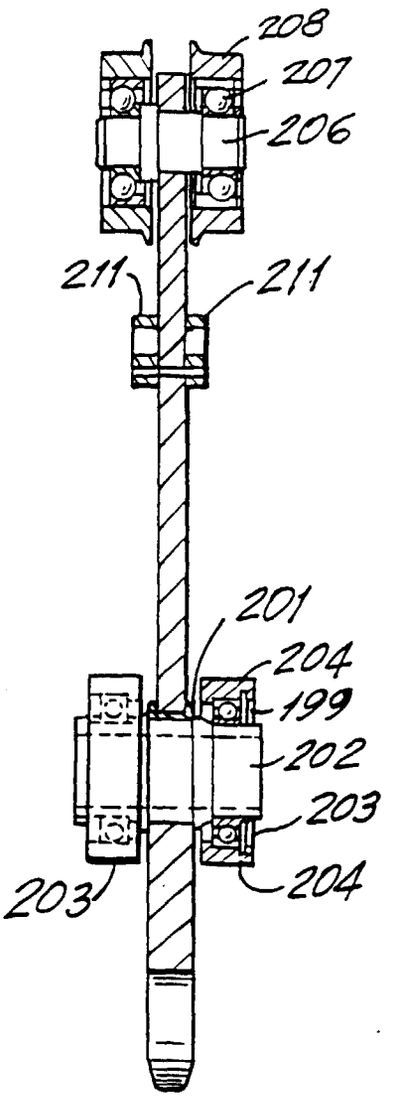
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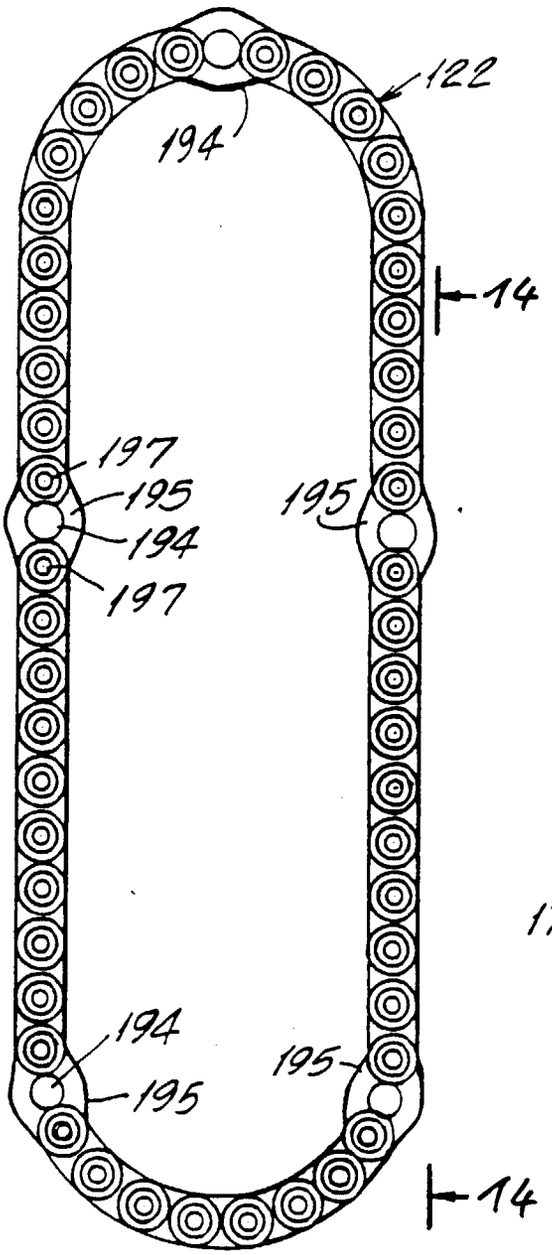
FIG. 11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14

FIG. 13

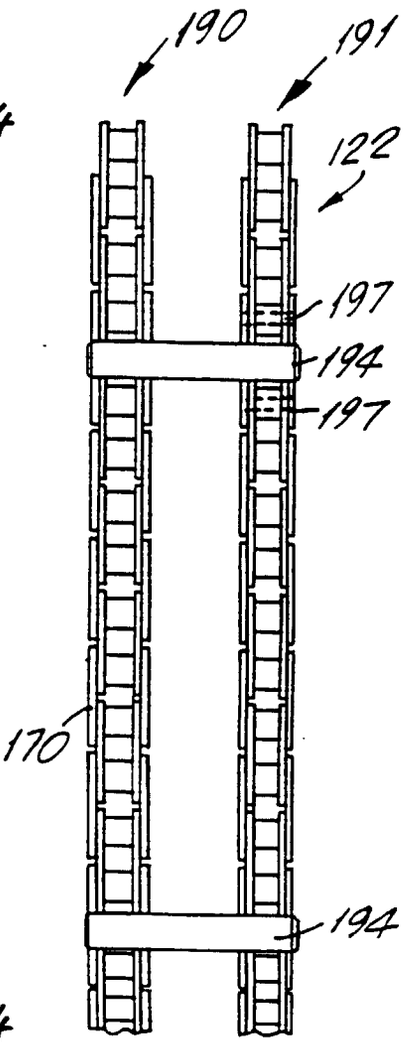

190
191
122
197
194
197
170
194

FIG. 14

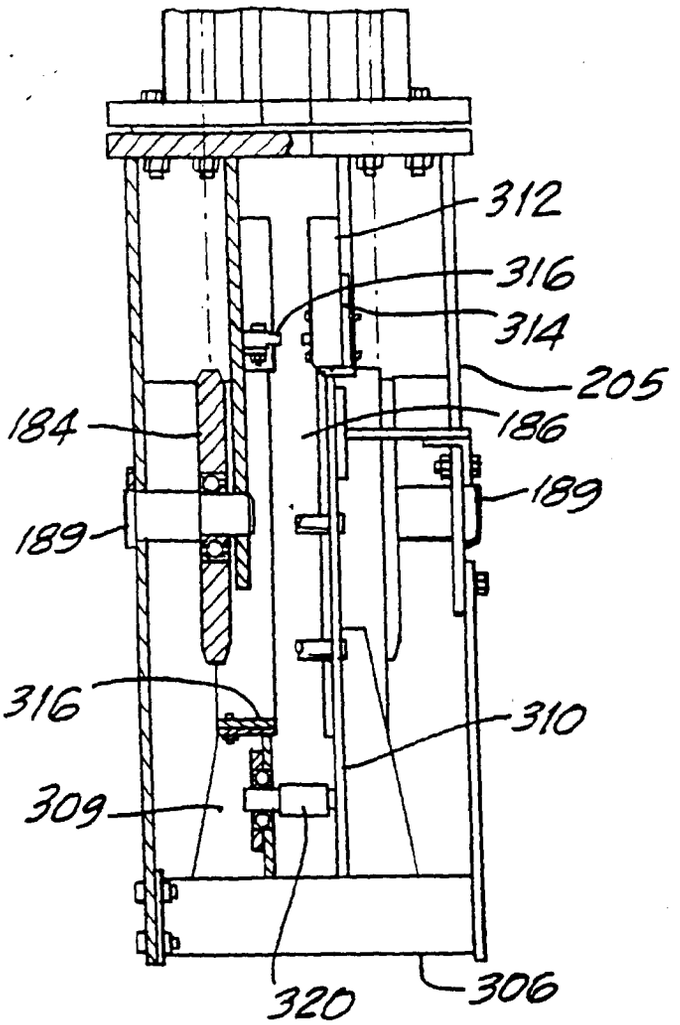


FIG. 15

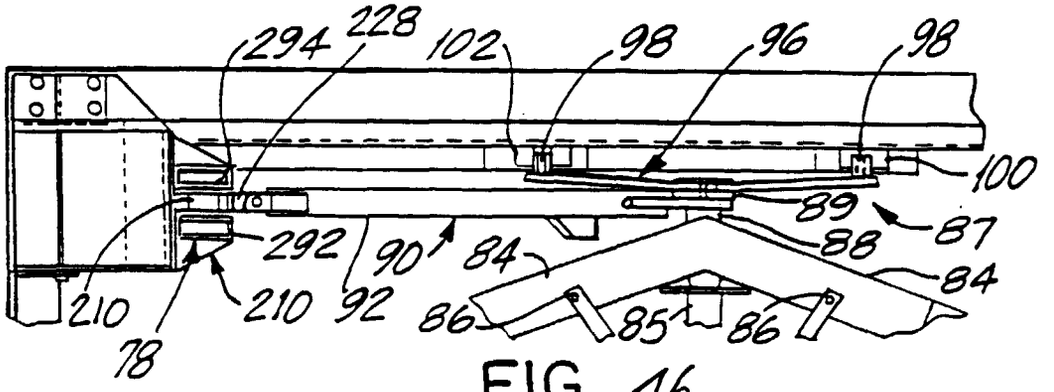


FIG. 16

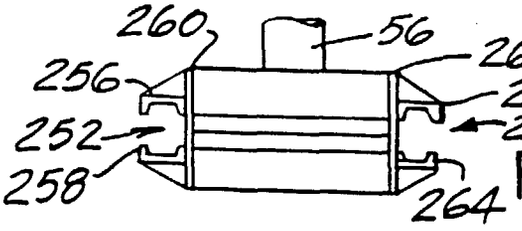


FIG. 17

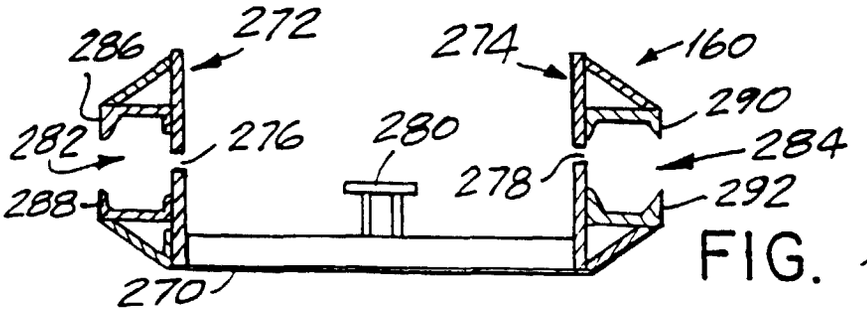


FIG. 18

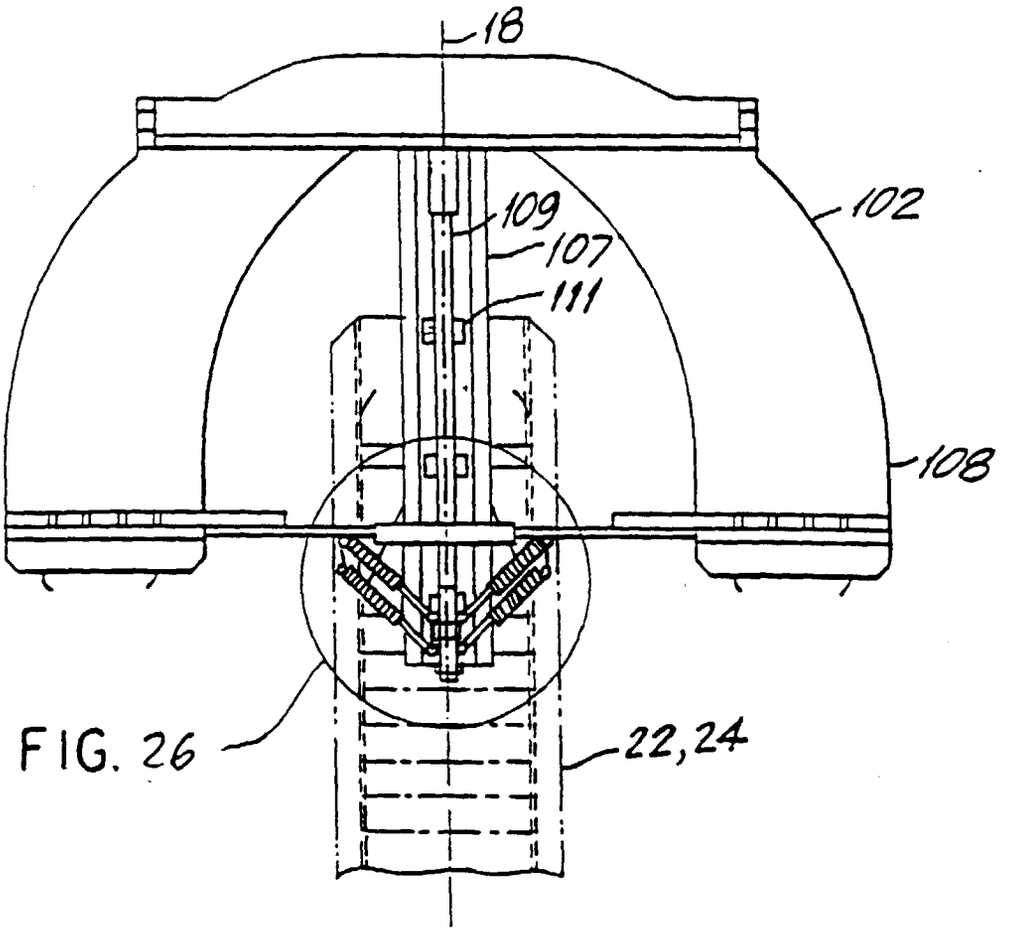
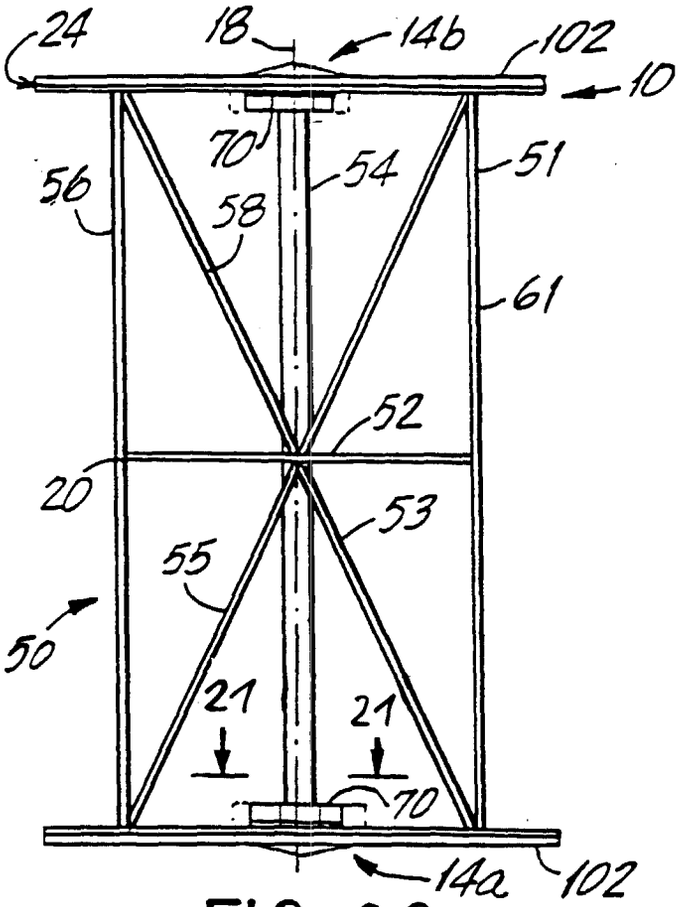


FIG. 26

FIG. 19


24
18
14b
102
10
70
54
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61
52
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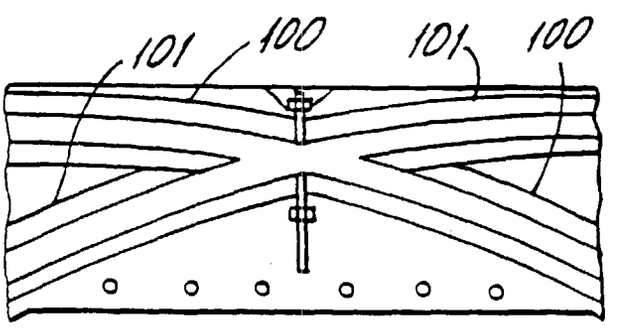
53
55
50
21
21
70
14a
102

FIG. 20


101
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101
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FIG. 21

FIG. 24

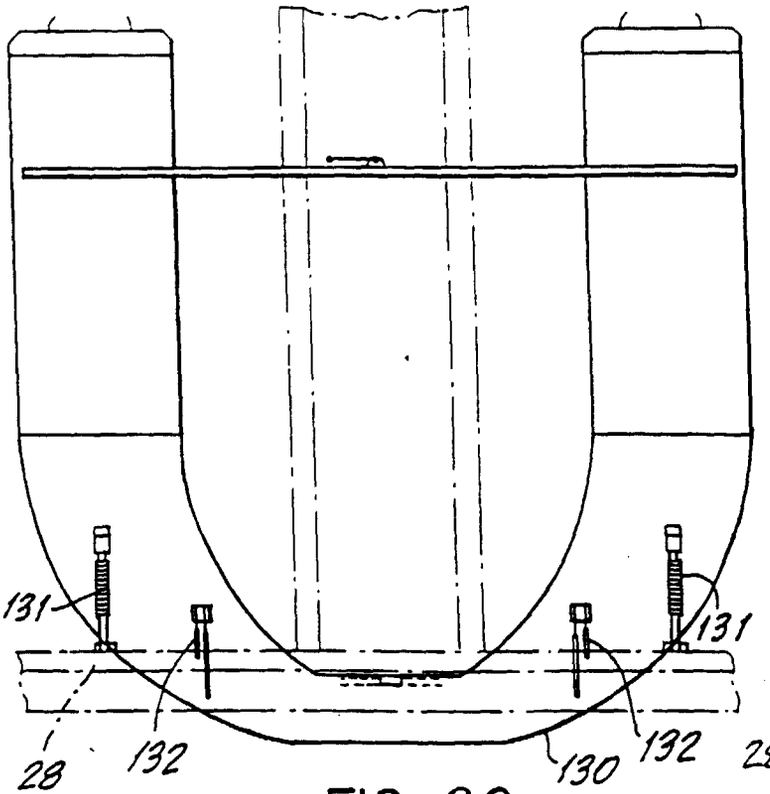


FIG. 22

FIG. 23

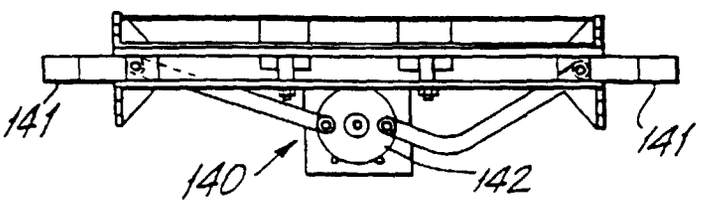


FIG. 25

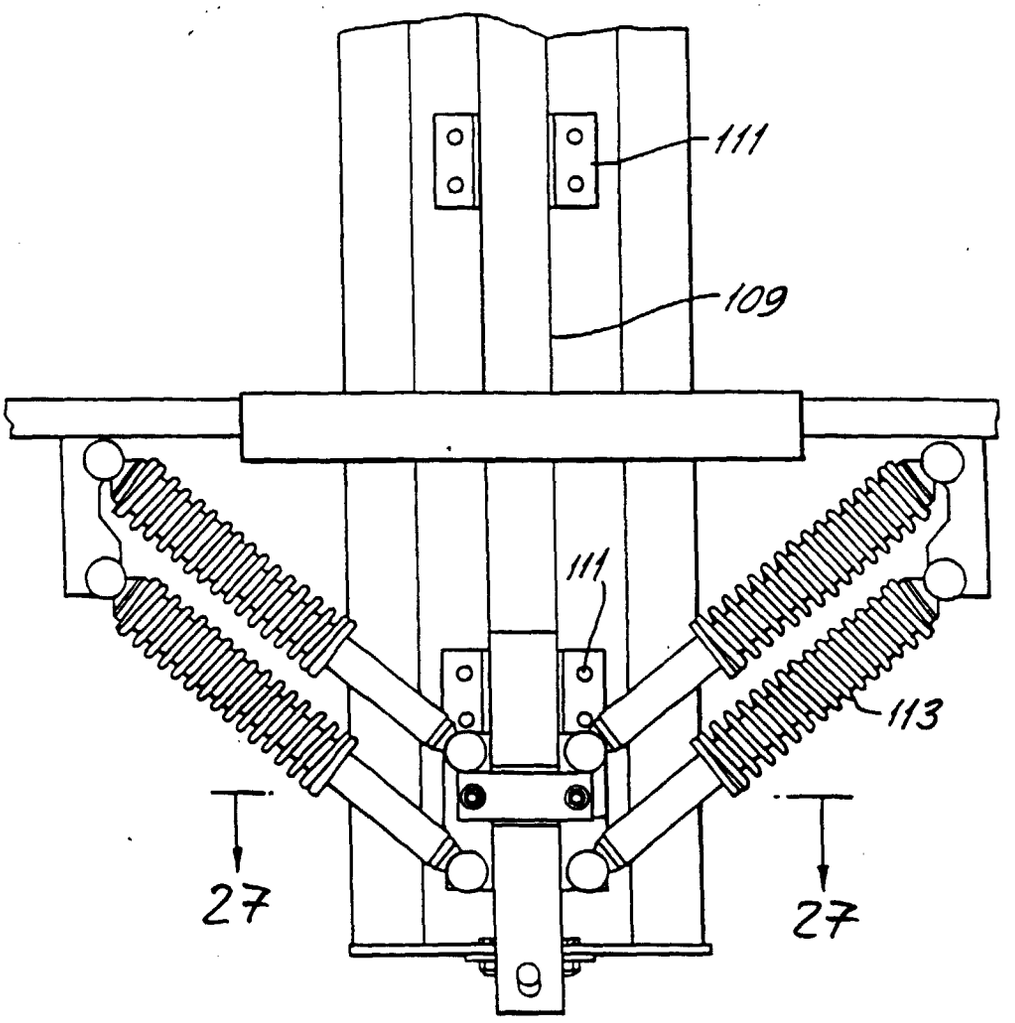


FIG. 26

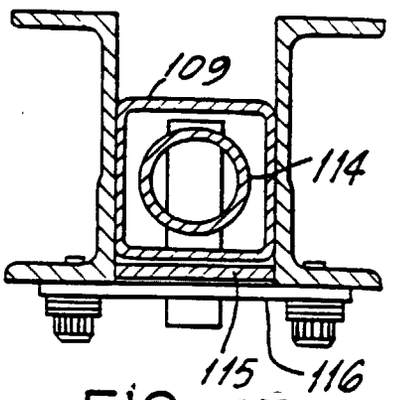


FIG. 27

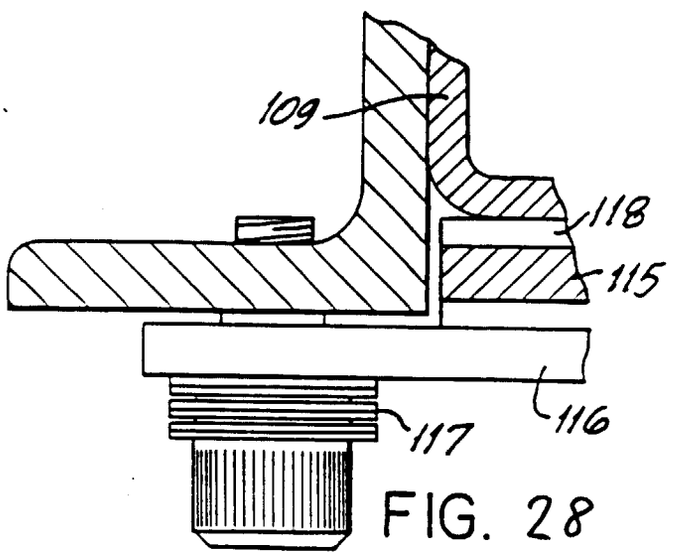


FIG. 28

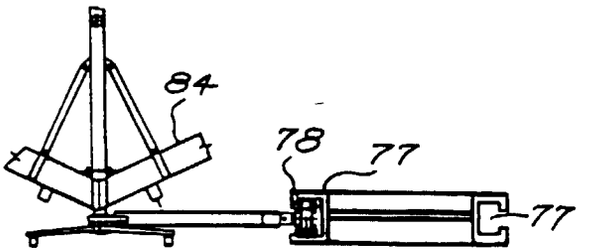


FIG. 29

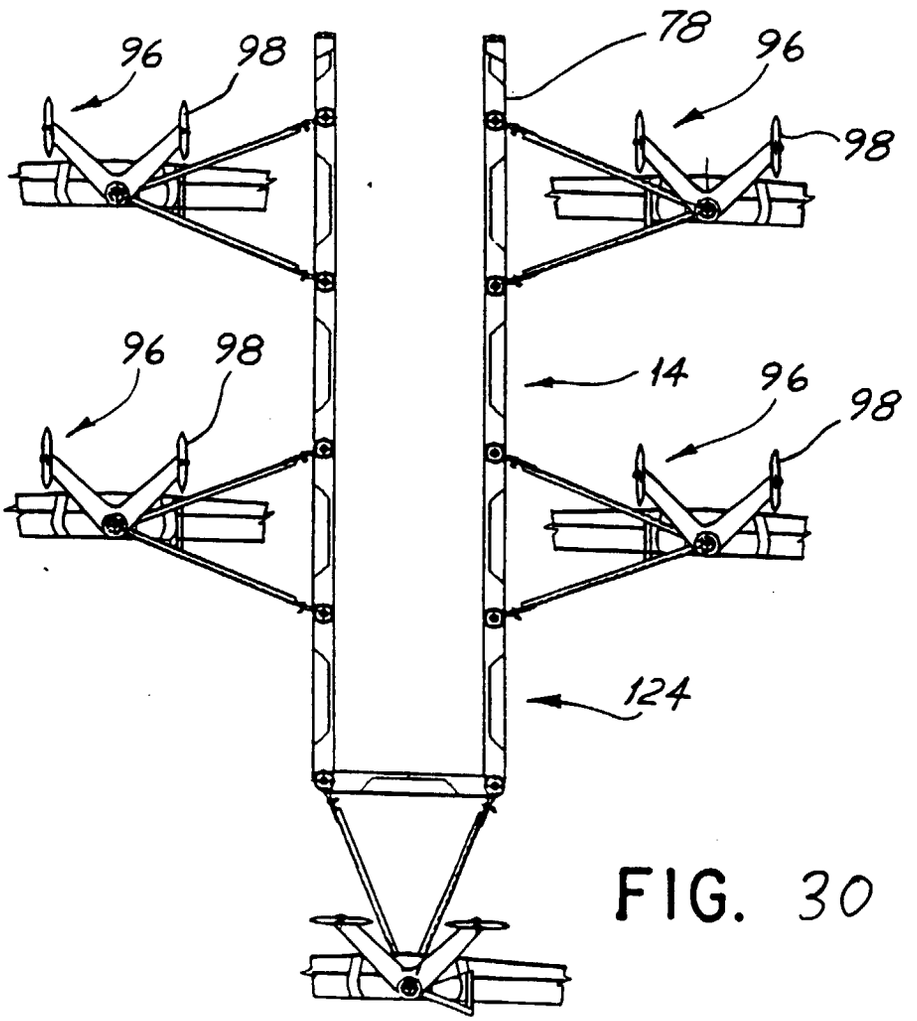
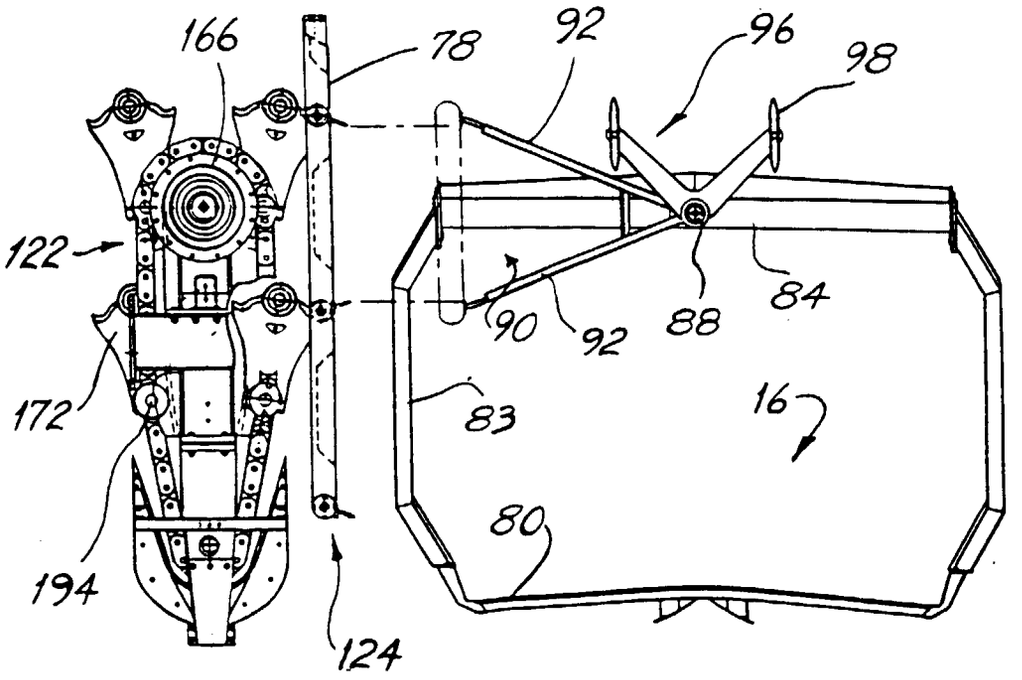


FIG. 30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122
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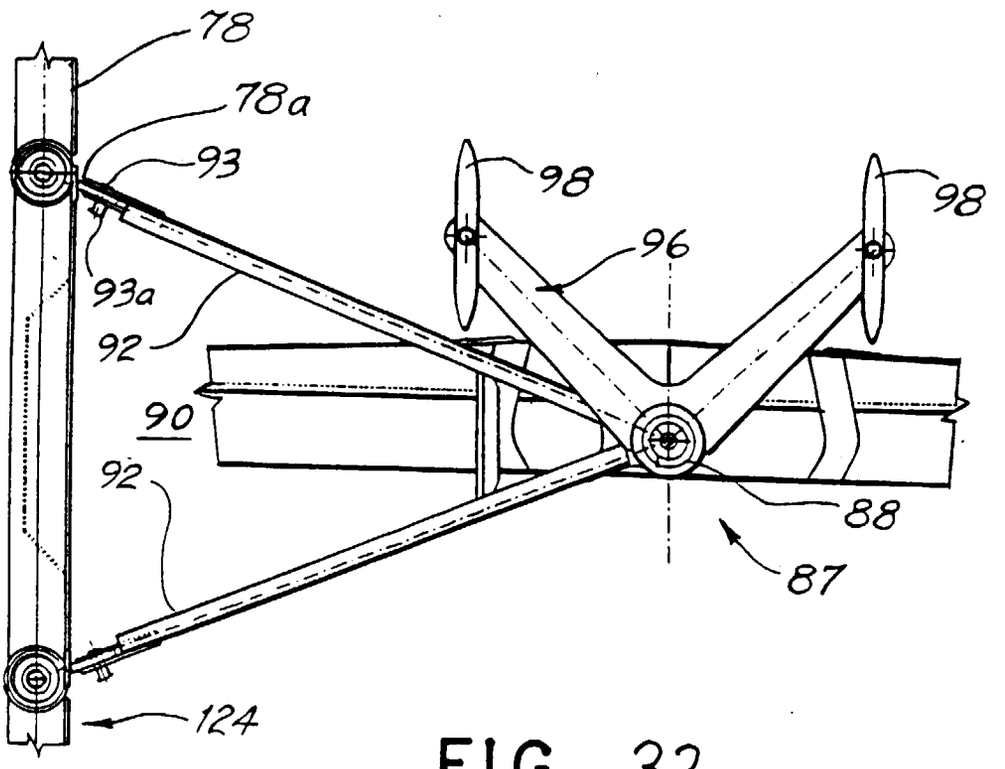
172
83
16
80
194
124

FIG. 31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78a
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98
98
96
93a
92
90
92
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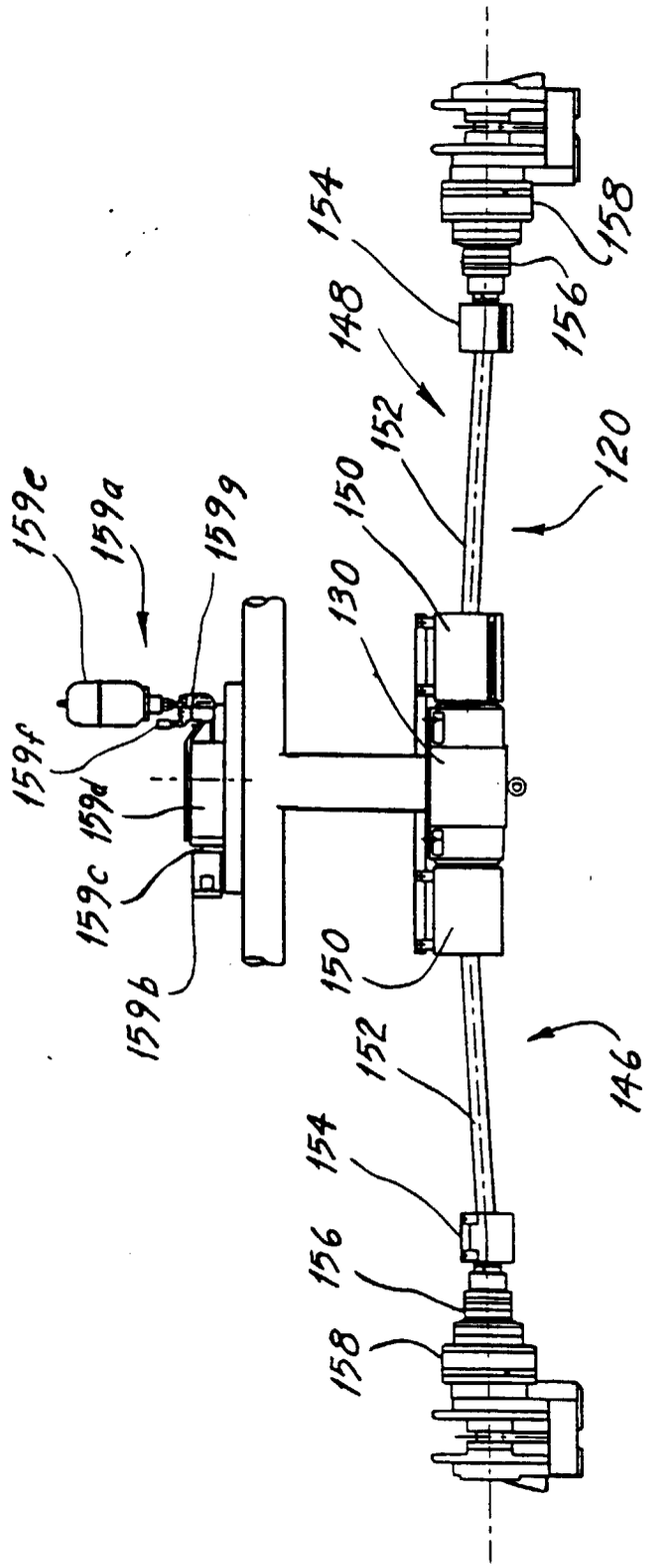
87
124

FIG. 32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158
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152
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159c
159a
159g
130
159f
159d
159c
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FIG. 33

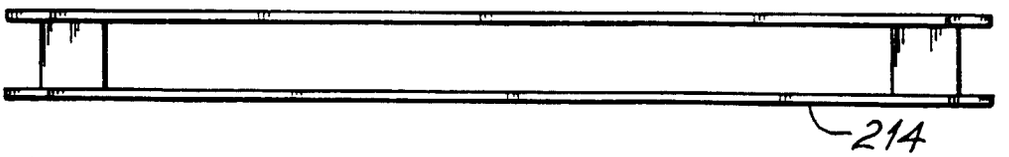

FIG. 34

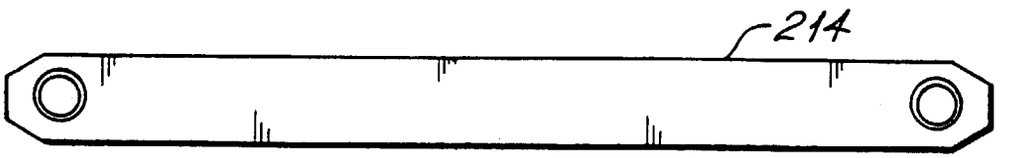

FIG. 35

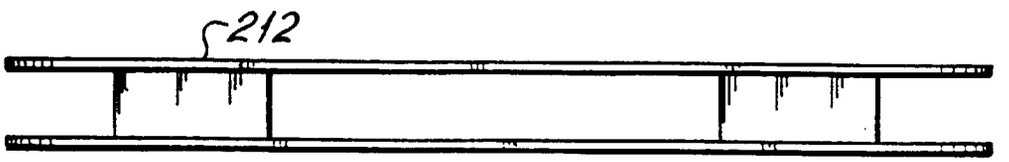

FIG. 36

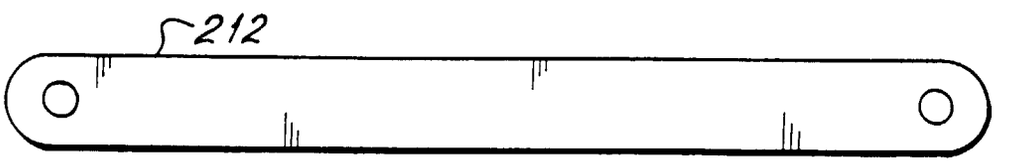

FIG. 37