United States Patent [19]

Alduk

[11] **3,833,132**

[45] **Sept. 3, 1974**

[54] **PALLET LOADING APPARATUS**

[76] Inventor: **Frank P. Alduk,** 116 Guadalcanal Rd., New Castle, Pa. 16105

[22] Filed: **Apr. 20, 1972**

[21] Appl. No.: **245,842**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 854,930, Sept. 3, 1969, abandoned.

[52] **U.S. Cl.** ..... **214/6 G,** 214/6 DK

[51] **Int. Cl.** **B65g 57/22**

[58] **Field of Search** ..... 214/6 DK, 6 H, 6 P, 6 G, 214/6 M, 6 N, 8.5 SS, 8.5 A; 198/35

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Primary Examiner—Robert J. Spar

Attorney, Agent, or Firm—Parmelee, Miller, Welsh & Kratz

[57] **ABSTRACT**

An apparatus for loading objects on a pallet has a cross frame movable vertically between upright supports. There is a shuttle table over the cross frame movably carried on it for travel from a load-receiving position at one end of the frame to a load-discharge position at the other end with means for traversing it back and forth. A restraining bar movable from a position where it is clear of the load when the table moves forward to a position over the pallet, but which obstructs the load as the shuttle table moves back, causes the load to be forced off the table onto the pallet or partially-formed load already on the pallet. One layer is deposited on the load with each forward and back cycle of the shuttle table. When the load is complete the cross frame is raised to a level above the load to clear the loaded pallet which is then removed, but at all other times the cross frame surrounds the load at or near its top to guard against accidental toppling of the load. An improved restraining bar is on dead center when it is in loadrestraining position with the pivotal axis about which it moves between load-restraining and load-clearing position so that the back thrust of the load against the bar is not transmitted to the bar-moving mechanism.

20 Claims, 24 Drawing Figures

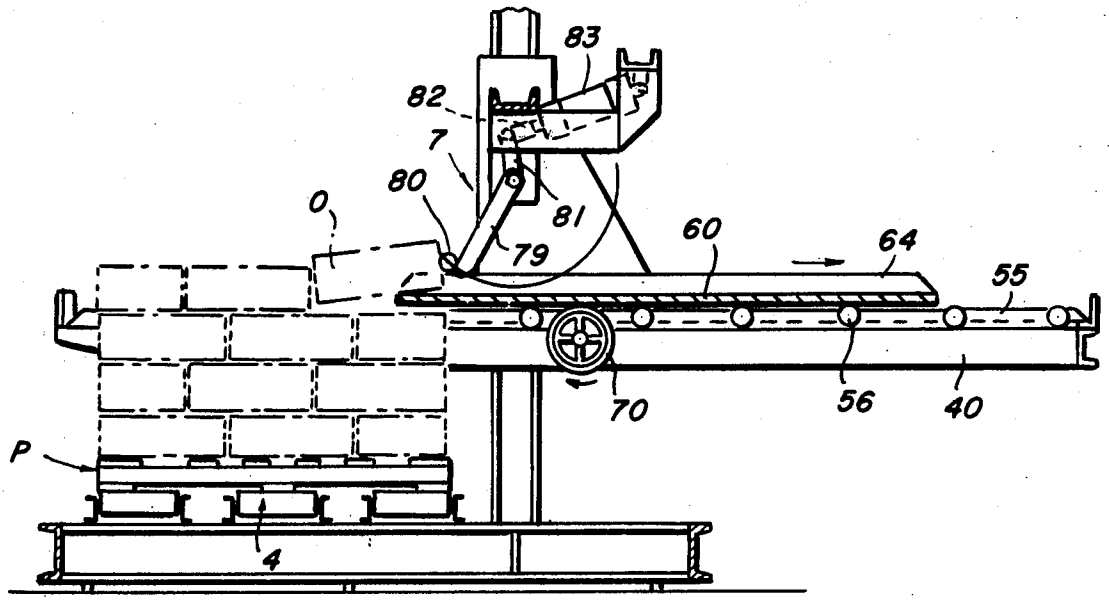

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FIG. 1

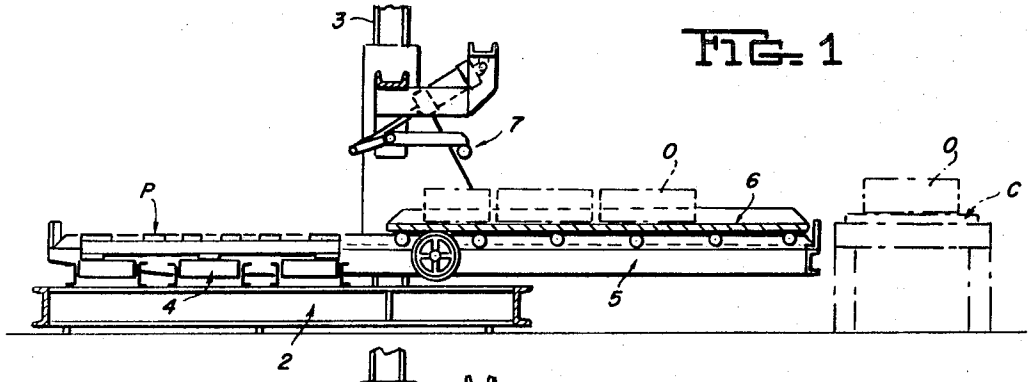
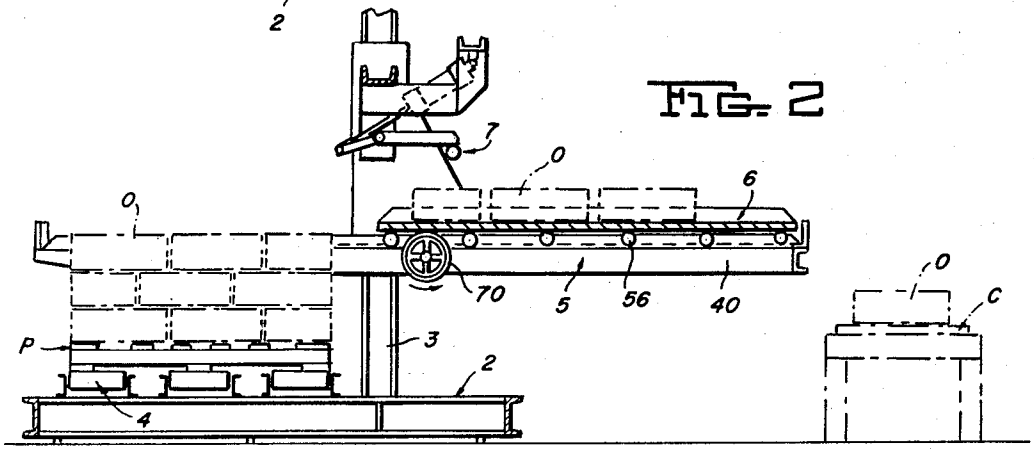


FIG. 2



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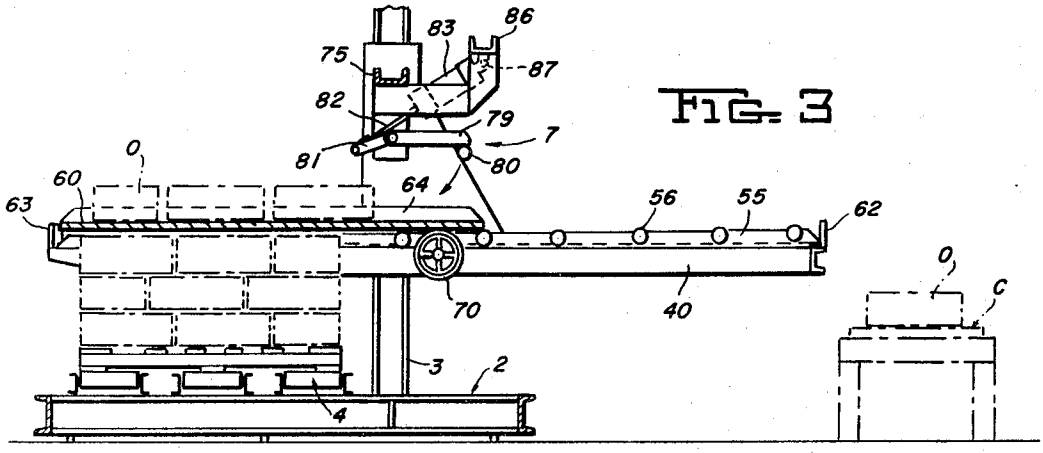

FIG. 4

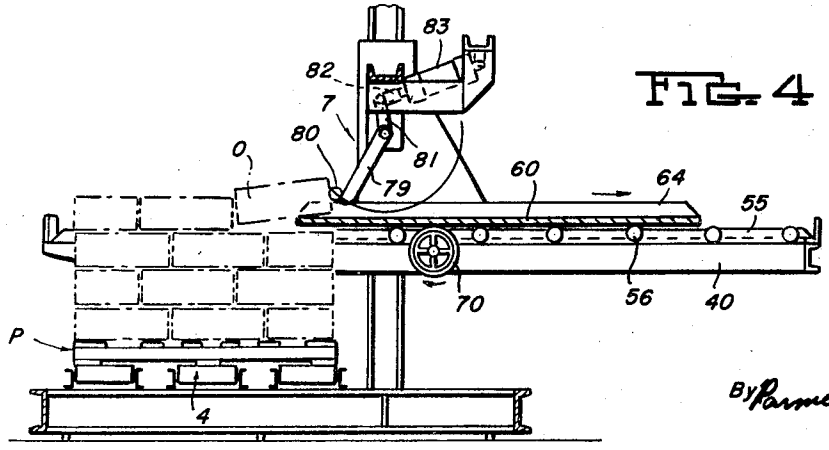

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FIG. 5

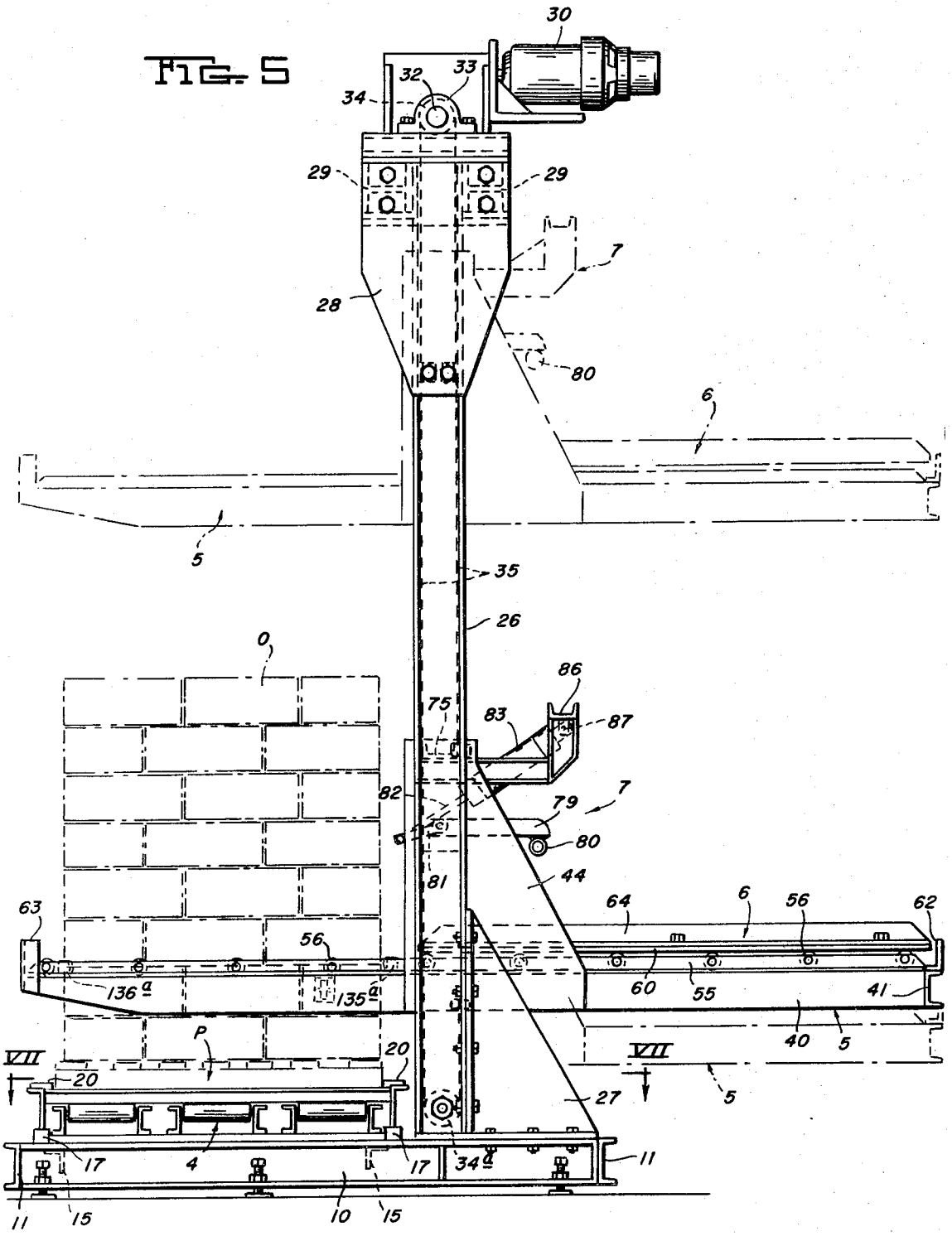

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FIG. 6

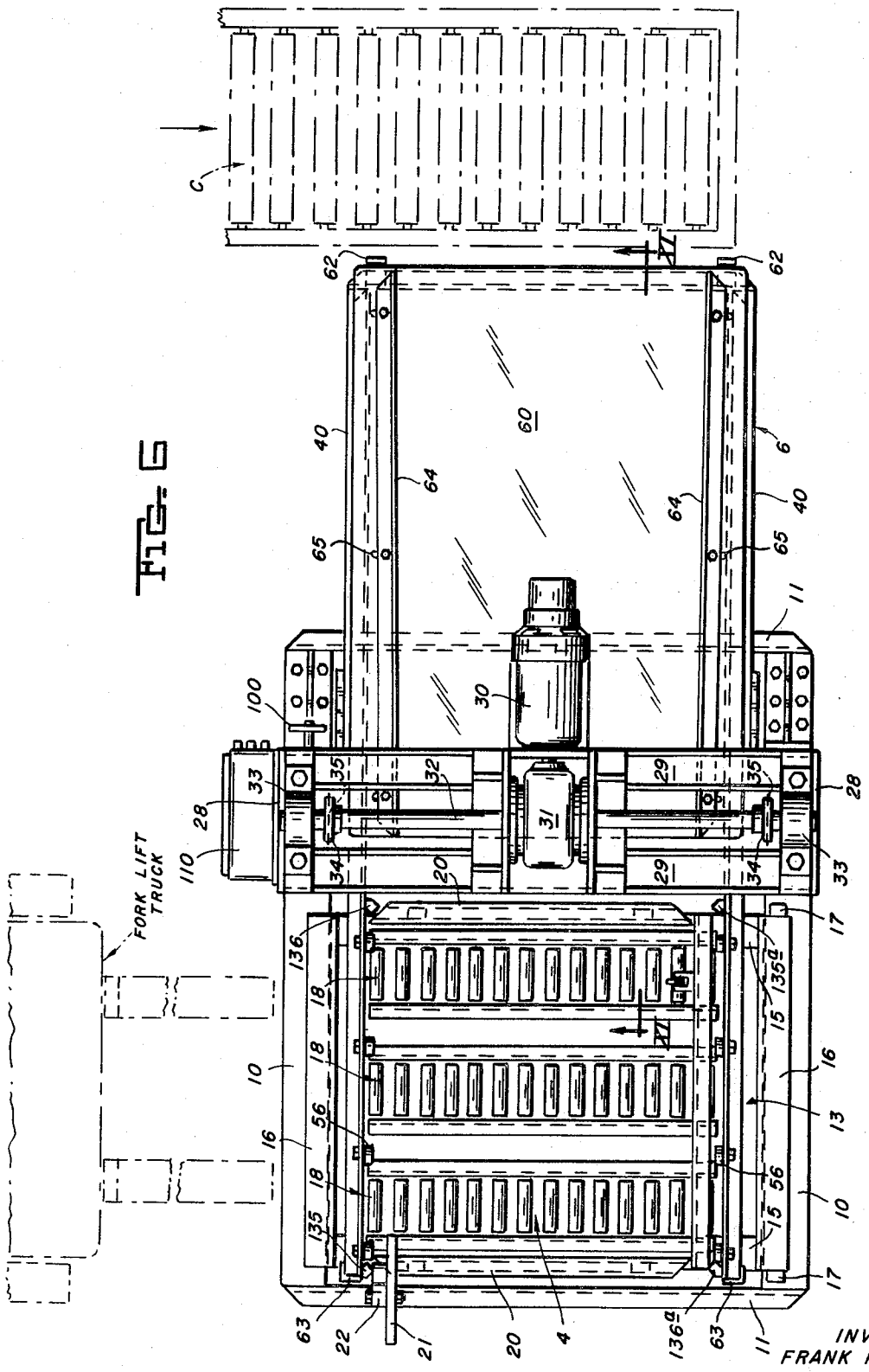

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FIG. 7

FIG. 8

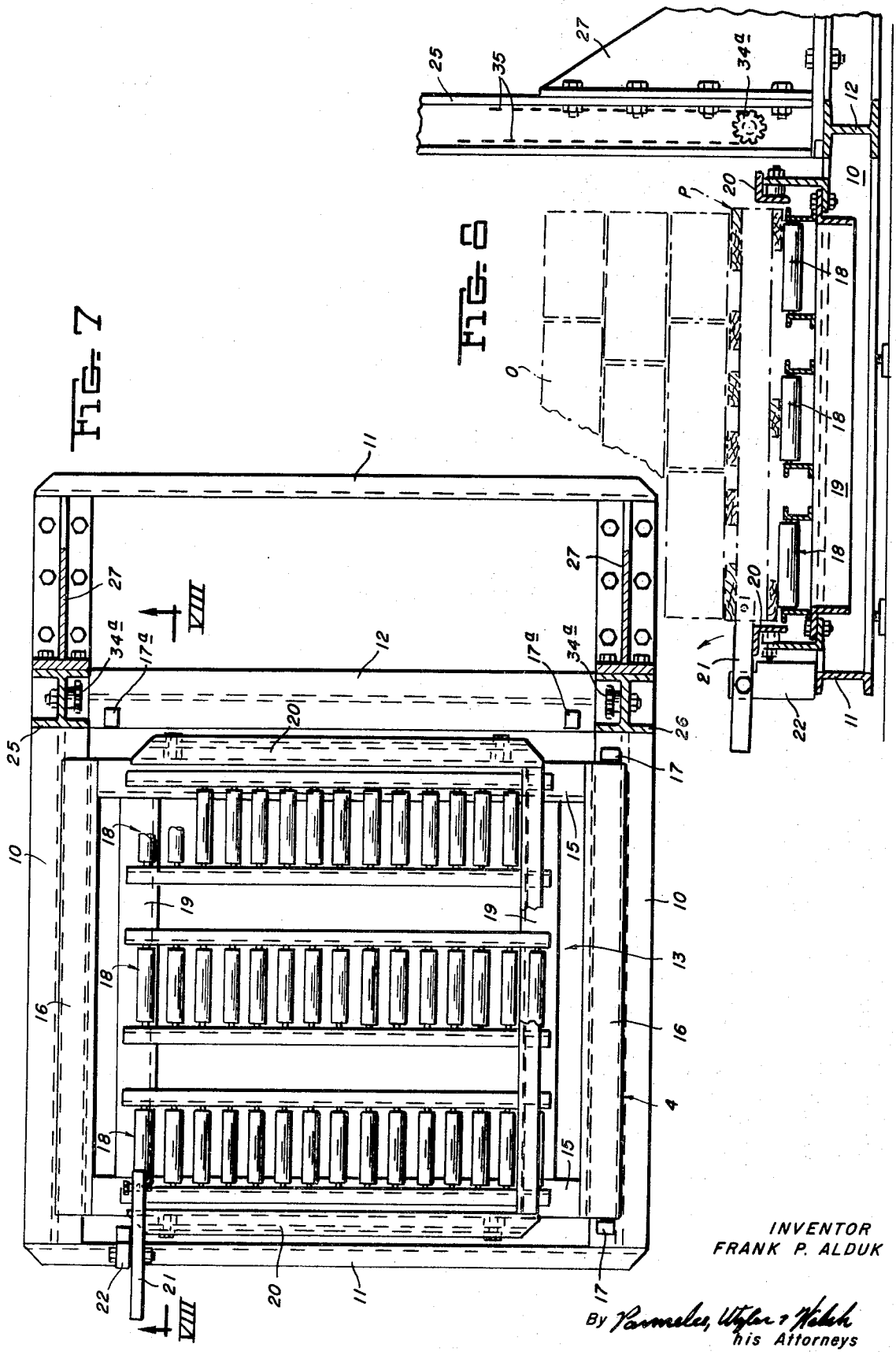

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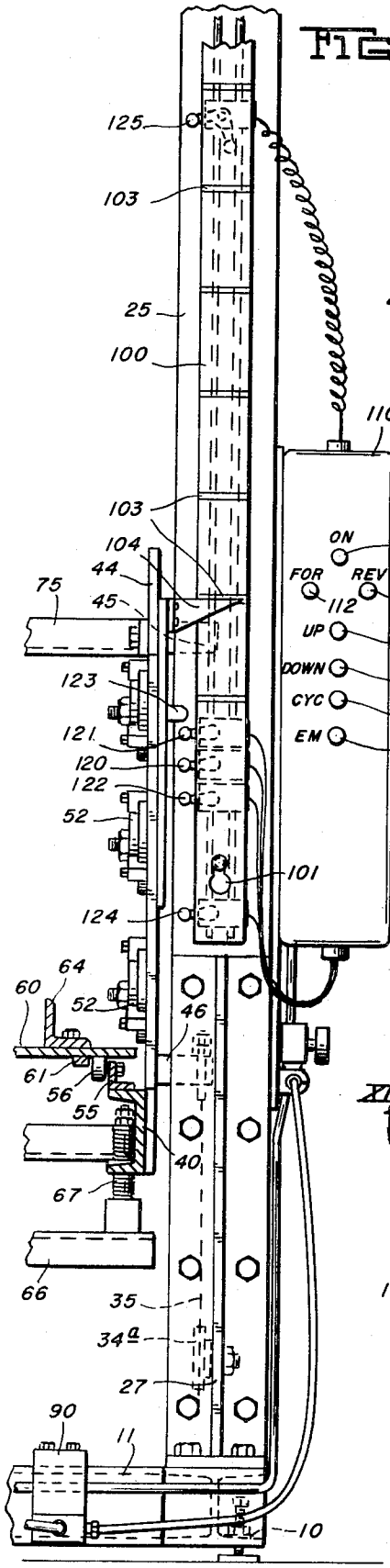
FIG. 10



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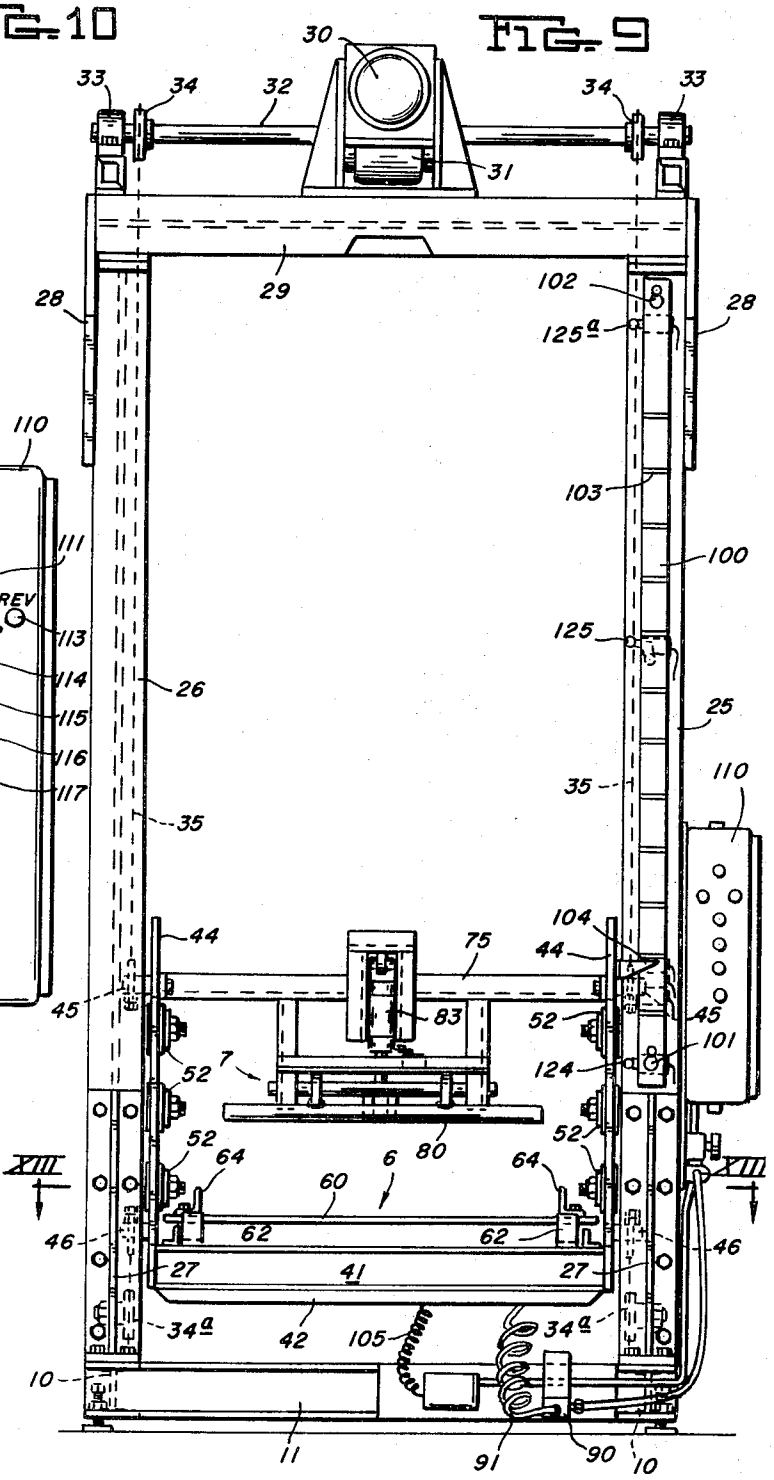

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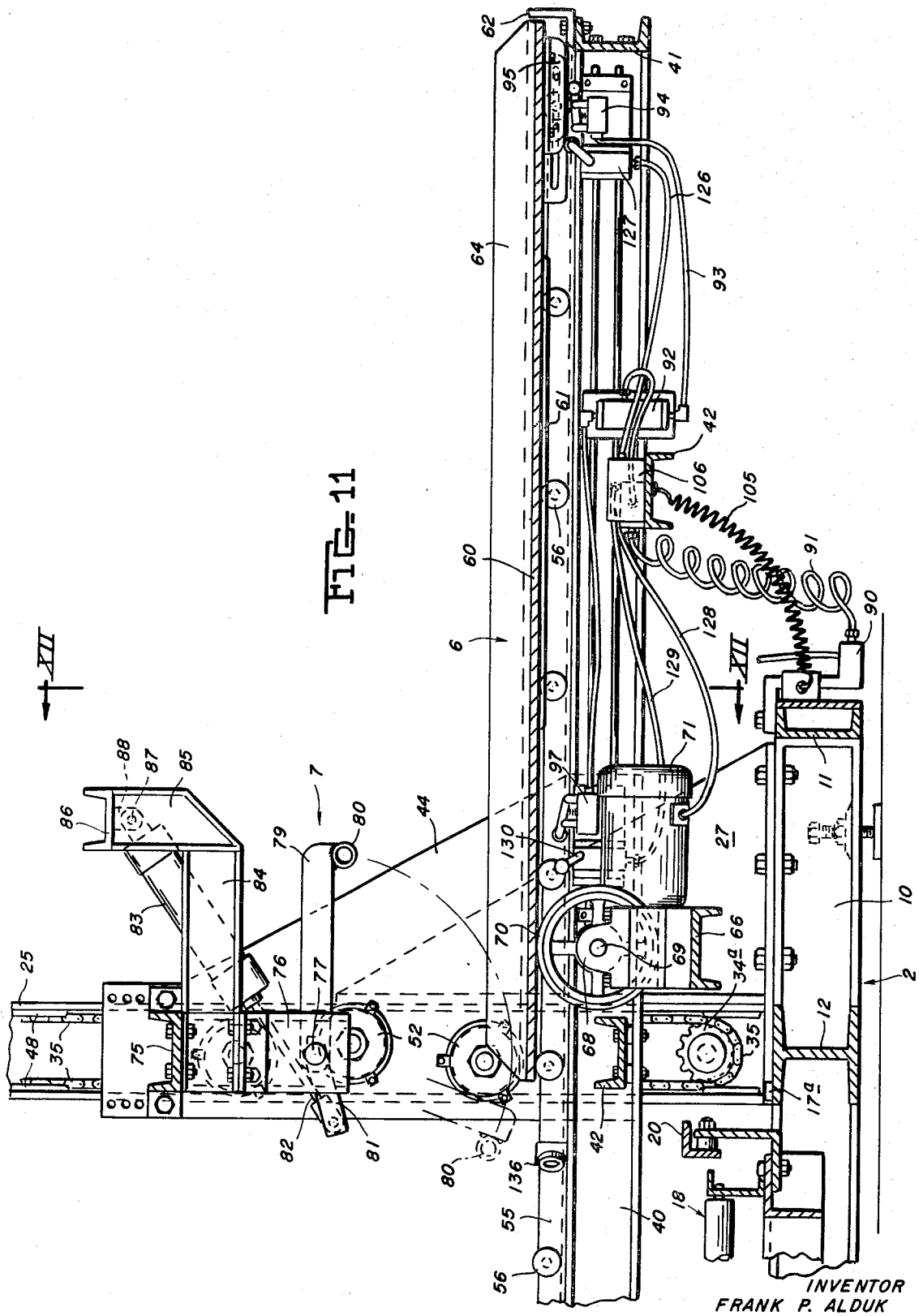
FIG. 11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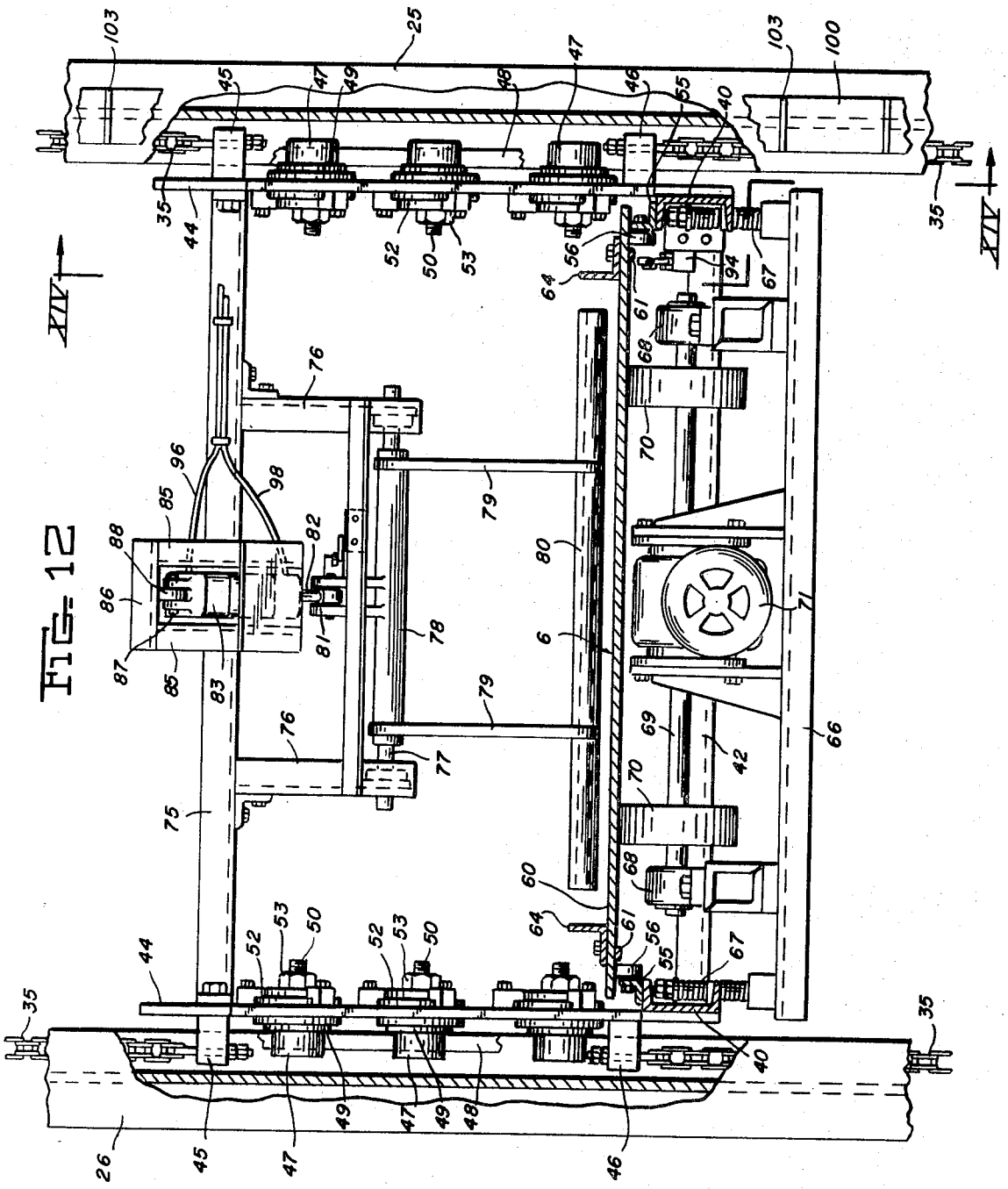

FIG. 12

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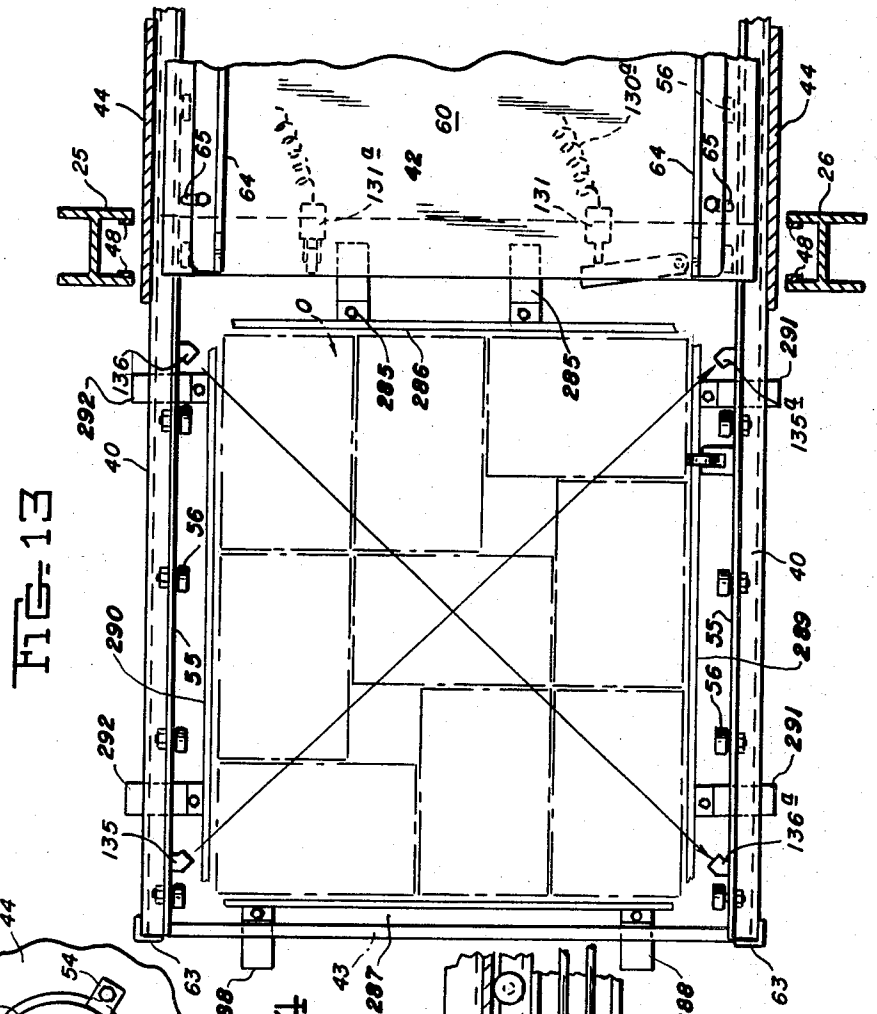

FIG. 13

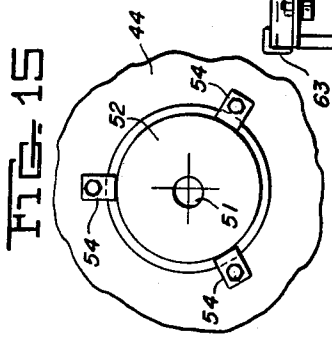

FIG. 15

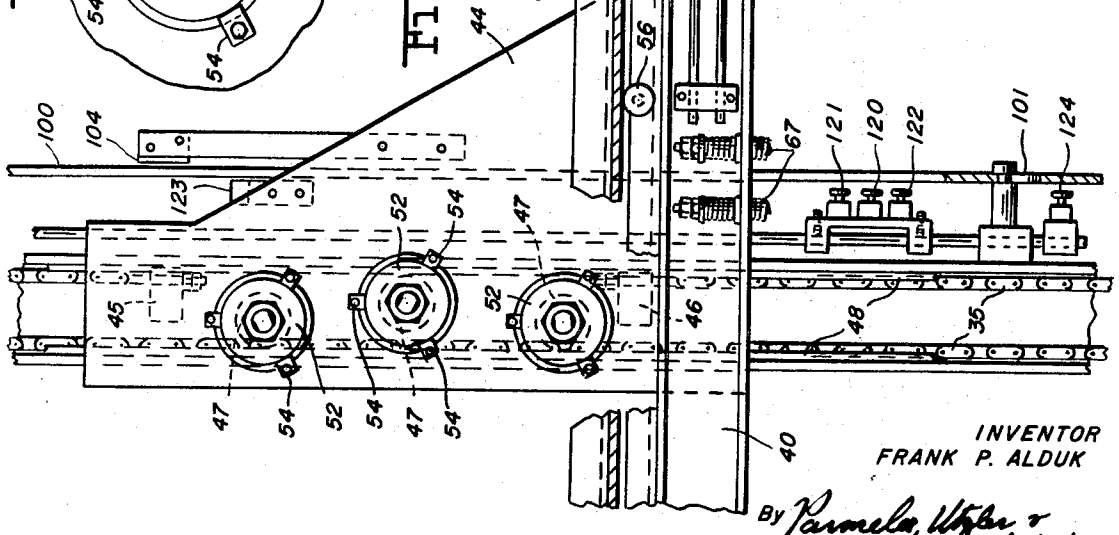

FIG. 14

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FIG. 16

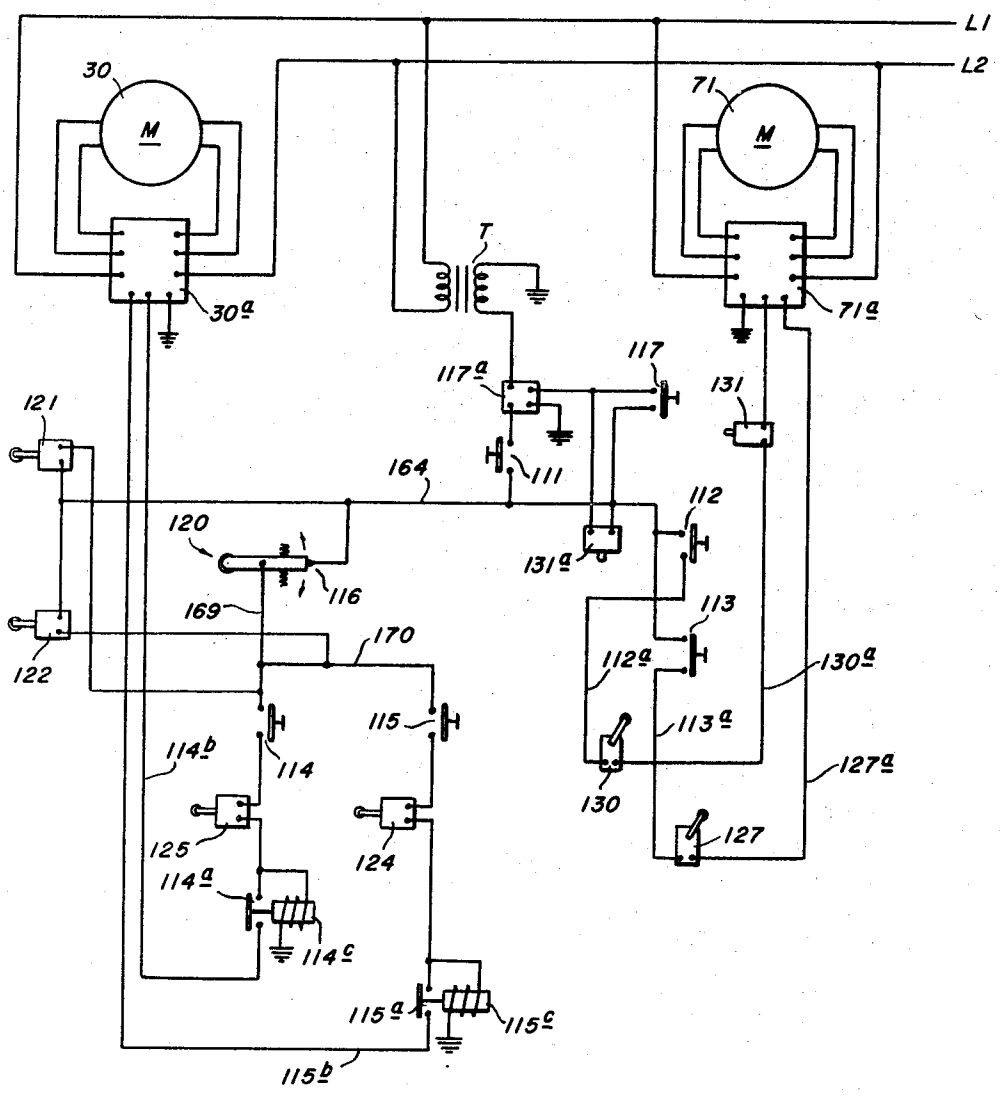

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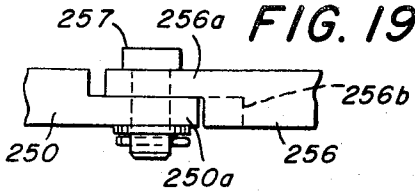
FIG. 19



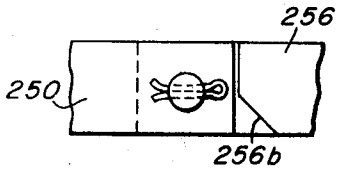


FIG. 20.

FIG. 17.

FIG. 18.

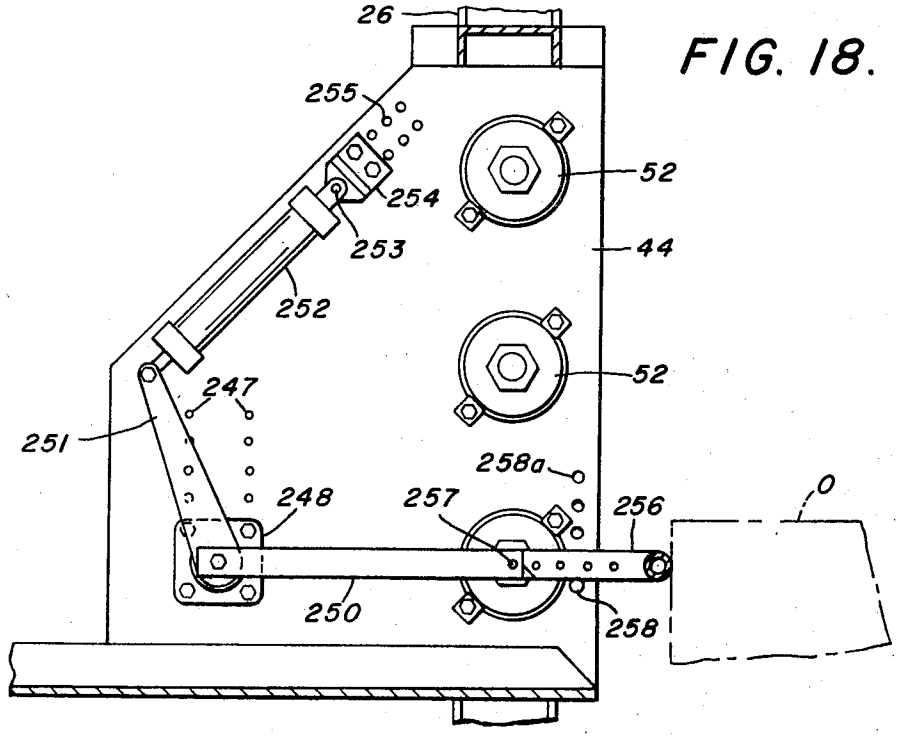


FIG. 21.

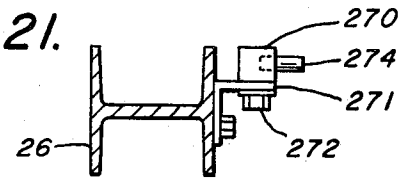


FIG. 22.

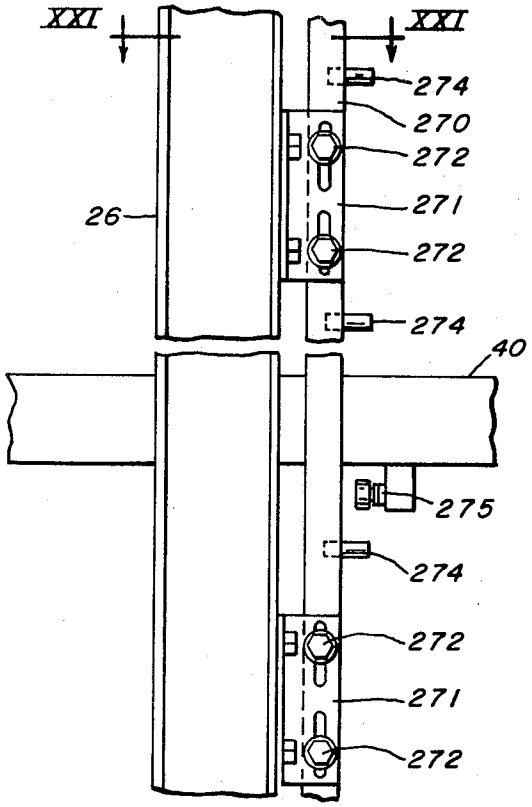


FIG. 23.

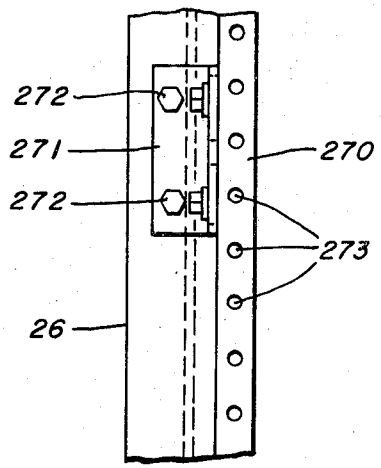
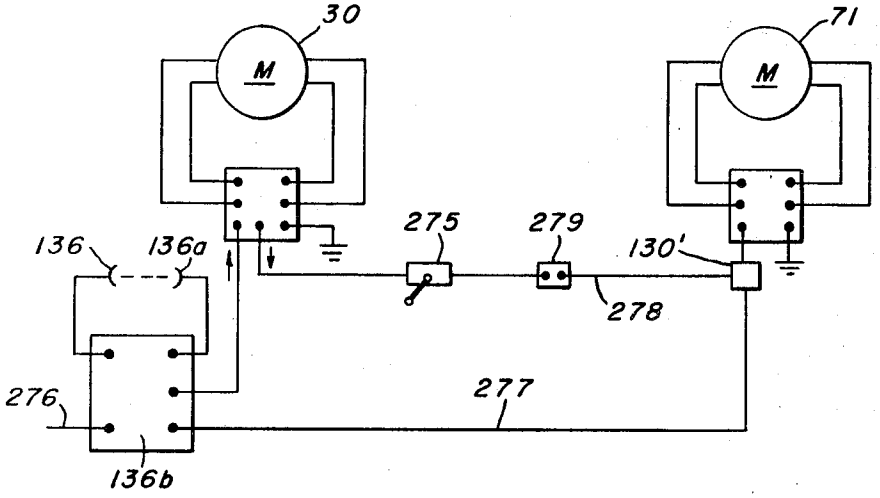


FIG. 24.



PALLET LOADING APPARATUS

This invention is for an apparatus for arranging and placing objects on pallets for transportation or storage, and this application is a continuation-in-part of my application Ser. No. 854,930 filed on Sept. 3, 1969, now abandoned.

BACKGROUND OF THE INVENTION

The stacking of various packages, cases, cartons, blocks and divers other objects on pallets for handling, storage and shipment is now extensively practiced, but in most instances the articles must be loaded onto the pallets and put in place, one at a time. Starting with a pallet at ground level, labor receives the articles from a conveyor or in some other manner where they are lifted individually and placed on the pallet in a prearranged pattern. At first the laborer must bend over to place the first one or two layers, but as the load builds up, he must lift the articles higher and higher, often to levels above his shoulders. In many cases the objects are heavy, such as cases of canned products, paint or solid articles such as building blocks, and in any event the work is tiring and may cause physical injury.

Attempts have been made to lighten this work, as by having an elevated work floor or platform with a pallet support that is lowered as the load on the pallet builds up, with the loaded pallet being removed at a lower floor, but this has many drawbacks, not the least of which is the fact that it is not feasible to provide the required ceiling height, or because of other limiting conditions in many plants, while another difficulty arises from the fact that the pallet supporting and lowering device must be heavy enough to accept the increasingly heavy load until the full load is placed on the pallet. There are other objections which need not be here explained. British patent **964,411** cited as a reference against the parent application of which this is a continuation-in-part discloses an apparatus designed to perform much the same function as that of the present invention but has certain drawbacks which will become more apparent as the description of my invention proceeds.

SUMMARY OF THE PRESENT INVENTION

The present invention provides a unique pallet loading structure comprising essentially a base having a palletreceiving roller table thereon almost at floor level onto which a pallet may be placed, and from which the loaded pallet may be easily pushed to a position where the loaded pallet may be engaged by a fork lift truck, or otherwise removed.

This base provides a support for an upright frame comprised of two spaced parallel structural columns, one at each side of the base. They are joined by a cross structure at the top. These columns provide a guideway for a verticallymovable horizontal cross frame comprised principally of two spaced horizontal beams carried on trolleys that ride on the uprights, and these beams are attached to the trolleys about midway between their ends so they extend through the upright frame and project outwardly at each side of the uprights. They are spaced from each other a distance such that they may straddle the pallet on the roller table when the cross frame is at its lowest position, and straddle the load on the pallet as it is progressively built up, never leaving a position where they support the load

against being toppled after the first few layers have been put in position until the load is completed. These beams extend a distance such that their ends are beyond the most remote edge of the pallet at one side of the upright frame. The beams at the other side of the frame extend outwardly beyond the upright frame about the same, or a slightly greater distance. A motor-driven mechanism raises or lowers the cross frame from a convenient "home" or starting level under the control of an operator.

Above the cross frame and supported on it for back and forth travel is a shuttle table that is moved between a retracted position at one side of the vertical frame to an extended position at the other side of the vertical frame where it is then positioned over the pallet-receiving roller table on the base below it. With the shuttle table in the retracted position and the cross frame at the home or loading level, the operator places the objects in a layer of the desired pattern on the shuttle table which is accessible on three sides for receiving and arranging the load. The cross frame is then lowered or raised, depending on the extent to which the pallet has been loaded, to a level just above the level at which the objects are to be laid, and then the shuttle table is moved back while a restraining bar, forming part of the cross frame assembly, moves into position behind the layer of objects to keep them from riding back with the shuttle table, so that the objects drop onto the pallet, or the previously-formed load on the pallet, as the shuttle table moves back.

Since the cross frame always returns to its home position for loading, this position is arranged to be of a convenient height for the operator in order to avoid a minimum of lifting, stretching, or bending. The weight of the load on the pallet is always on the fixed roller table, and not on an elevator or movable platform, and provision of an elevated floor for loading is unnecessary.

A primary object of the invention is to provide a pallet loading apparatus of unique construction designed to reduce the manual labor generally required for this work, and which ordinarily is useful in commercial buildings without alterations of the building or the construction of elevated platforms.

A further important object is to provide a machine for this purpose which will adapt itself to various arrangements of floor space in different plants where it is used.

A still further object is to provide a machine for loading pallets which is relatively simple and inexpensive compared with machines heretofore provided for this purpose, and which embodies safety features designed to protect the operator and the load against error in its operation.

These and other objects and advantages are secured by my invention as will be understood by those skilled in the art in the light of the following detailed description thereof in conjunction with the accompanying drawings showing a present preferred embodiment of the invention. In the drawings:

FIGS. **1** to **4** are more or less schematic longitudinal sections through the machine showing various operating conditions;

FIG. **5** is a side elevation of the apparatus;

FIG. **6** is a top plan view of the apparatus shown in FIG. **5**;

FIG. 7 is a horizontal section in the plane of line VII—VII of FIG. 5 showing the base structure and roller table, other parts of the machine not being shown;

FIG. 8 is a detail longitudinal section in the plane of line VIII—VIII of FIG. 7, part of the base structure being broken away and showing a pallet in place with a partial load on the roller table;

FIG. 9 is a front elevation of the machine looking from the load-receiving end;

FIG. 10 is a side elevation on a larger scale of one of the columns of the vertical frame, the view here shown being the right-hand column as viewed in FIG. 9, the upper part of the column being broken away;

FIG. 11 is a longitudinal vertical section through the machine in the plane of line XI—XI of FIG. 6 with the top portion of the vertical frame being omitted;

FIG. 12 is a transverse vertical section in the plane of line XII—XII of FIG. 11;

FIG. 13 is a horizontal section in approximately the plane of line XIII—XIII of FIG. 9, but on a larger scale, and showing the shuttle table retracted with the previously-established load on the pallet, and showing electric eye controls;

FIG. 14 is a fragmentary section in the plane of line XIV—XIV of FIG. 12;

FIG. 15 is a detail front elevation of one of the guide roller mountings shown in FIG. 14;

FIG. 16 is a simplified basic control circuit diagram;

FIG. 17 is a fragmentary side elevation of the inside face of one of the side plates of the vertically movable frame showing a modified restraining bar arrangement with the bar in its uppermost position, the view actually being a section along the center-line of the apparatus;

FIG. 18 is a similar view with the restraining bar in operative position;

FIGS. 19 and 20 are fragmentary enlarged detail views of the hinged side arms on which the restraining bar is carried, FIG. 19 being a top view and FIG. 20 a side view;

FIG. 21 is a transverse section through one of the upright columns 26, with a modified control arrangement fixed thereto;

FIG. 22 is a side elevation of the column of FIG. 1 with the attached parts, showing one of the side frame members 40 to indicate the cross frame and shuttle;

FIG. 23 is a fragmentary view at right angles to FIG. 22; and

FIG. 24 is a block type circuit diagram of a portion of the circuit to which the parts shown in FIGS. 21 to 23 relate.

The invention may perhaps be best understood by a general description of the basic parts of the machine and brief reference to the operation followed by a more detailed description of the several parts. To this end, reference will first be made to FIGS. 1 to 4, wherein 2 designates generally a structural base frame to which is secured a fixed upright frame designated generally as 3. A roller table 4 is set in the base frame at one side of the upright frame. There is a vertically movable horizontal cross frame, designated generally as 5, and it is mounted for vertical movement in the upright frame. It extends through the upright frame with one end extending to the left (as here shown) above and beyond the roller table 4, and the other end extends to the right of the upright frame a slightly greater distance. Movable horizontally above and supported on the cross frame is a shuttle table 6. There is a restraining bar and its operating mechanism designated generally at 7 mounted in the cross frame movable in an arc from an elevated load-clearing position shown in FIGS. 1, 2 and 3 to the load-engaging and restraining position in FIG. 4. A pallet P is shown in place on the roller table, and C represents a conveyor or other means on which the objects, O, to be loaded, are brought to the loading apparatus at a convenient height above the floor.

The schematic views 1 to 4 show graphically the general operation. In FIG. 1 the dotted line position shows the normal "home" or loading level of the cross frame, at which level the objects are moved without lifting from the conveyor C and where they are manually arranged more or less according to pattern on the shuttle table 6. The pallet in FIG. 1 has no previously-deposited load, so, under the control of the operator, the cross frame 5 is dropped to its lowest level where the shuttle table is in a plane just about an inch or so above the top of the pallet.

FIG. 2 is about the same as FIG. 1 but shows in broken lines three layers of objects already on the pallet, and the cross frame is just about at the home level. When the load on the pallet is above the home or loading level, it is moved upwardly from the home level to deposit the load which is placed on the shuttle table.

FIG. 3 shows the next operation after the load has been placed on the shuttle table and the cross frame is at the proper level. In this position the shuttle table is moved forward or to the left to the limit of its travel, and as previously indicated it would, with the condition shown in FIG. 1, just clear the top of the pallet by about an inch, and in FIG. 3 it has about the same clearance above the previously-formed layer on the pallet.

FIG. 4 shows the next operation in which the restraining bar has been moved from a raised load-clearing position of FIGS. 1 to 3 to a load-obstructing position behind the load on the shuttle table. The shuttle table is moving toward the right as seen in this figure, sliding under the objects which are now restrained from moving with the table and crowding onto the pallet, or the previously-deposited load on the pallet.

With this brief description, the detail of the construction of the various parts may now be followed.

THE BASE FRAME AND UPRIGHT FRAME STRUCTURE

The base 2, which is best shown in FIGS. 5, 6, 7 and 8, is generally rectangular in shape and is comprised of elongated parallel structural side members 10 connected at their opposite ends by structural cross members 11. Intermediate the length of the side members, but, as shown in FIG. 7, between the middle of the length of the rectangle and the right end, there is an intermediate cross member 12. This provides an almost square open space 13 between the intermediate cross member 12, the left end cross member 11, and the two side frame members 10.

The roller table unit 4 set into this square space 13 which comprises generally a rectangular frame having main side bearing bars 15 and end cross bars 16, all rigidly connected together. The two ends of this frame are here shown as setting on the two side members 10 of the base (see FIG. 7) with the table frame at one end being positioned between spaced lugs 17 on one of the base side frame members 10. However, as hereinafter

more fully explained, this frame may be turned 90° from this position so that the end cross bars rest on the intermediate cross bar **12** and the left base end member **11,** the frame then being positioned between lugs **17***a* on the intermediate cross member **12.**

The table frame structure **15–16** supports a plurality, preferably three, spaced parallel roller conveyor units **18** of familiar construction, there being cross members **19** in the frame **15** and **16** for supporting these roller conveyor units. In FIG. **8** a pallet P of the usual wooden construction is indicated in position on these roller conveyors **18** so that the pallet is firmly supported in a level position, but it can be rolled off the roller table to one side or the other, the pallet moving of course in a direction at right angles to the rollers. However, in some plants the floor arrangement may not accommodate an operation where the pallets are moved off one side or the other of the base, and in this case, the table is turned **90°** to the position shown in FIG. **7,** as previously explained, and then the conveyors will extend in the direction of the length of the base, enabling the pallets with their loads to be moved off the end of the base instead of off one side or the other. If desired, the roller conveyors may be power-driven in a manner now well known in the art.

There is an advantage of providing a roller table pallet support carried by, but separate from the base, since it enables one model of a machine to fit into the requirements of the plant where it is used without being specially constructed for its environment. While this is a desirable feature, it will be apparent that any roller table could be provided on the base in its place. To enter the pallet for the loading operation to be hereinafter described, there are side guides **20** along each side of the roller table. There is also a movable stop bar **21** provided on a bracket **22,** which stop bar in the horizontal position shown in FIGS. **7** and **8** obstructs the free movement of the pallet on the roller table when the pallet abuts it, but as indicated by the arrows in FIG. **8,** the stop bar may be raised in an arc out of pallet-engaging position.

The upright frame comprises two spaced parallel structural columns **25** and **26,** preferably of H section with the cross bar of the H parallel with the base members **10.** One of these columns is secured to each of the base members **10** in line with the intermediate cross member **12** of the base. Angle braces or gusset plates **27** are provided for securing them to their respective base structures **10** and keep them perpendicular.

As best seen in FIGS. **5, 6** and **9,** the tops of these columns each have structural plates **28,** and there are two structural cross members **29,** one at each side of the columns, secured to these plates for connecting the tops of the columns and keeping them parallel.

The cross bars **29** also provide a support for a reversible motor **30,** and reducing gear **31** for driving a cross shaft **32** carried in bearings **33,** one of which bearings is at the top of each vertical column **25** and **26.**

It will be noted that the columns **25** and **26,** being of H section and set with the web or cross bar of the H parallel with the length of the base, each provide a channel in their respective confronting faces. There is a sprocket wheel **34** on the shaft **32** above each of these channels, and each channel has a similar sprocket wheel **34***a* (see FIGS. **6** and **9**) rotatable about a stub shaft close to the lowermost end of each column (see FIGS. **9, 10** and **11**). A sprocket chain **35** passes around the top and bottom sprockets **34** and **34***a* at each side of the machine, with the two vertical reaches of the chain being received in the channels of the respective columns.

The motor, reducing gear, shaft, and sprockets **34** and **34***a* provide the mechanism for raising or lowering the movable cross-frame assembly of the machine in the manner to be hereinafter described.

THE CROSS FRAME AND SHUTTLE TABLE ASSEMBLY

The vertically-movable cross frame comprises two parallel structural beams **40** of channel section (See FIGS. **5, 11, 12** and **13**). They extend through the upright frame with one of the beams being close to the inside face of each upright **3** so that the distance between them is slightly greater than the width of a pallet and about the same as or slightly less than the length of the roller conveyor units of the roller table **4.** As best seen in FIG. **5,** the forward or left ends of the beams extend from the vertical columns a distance beyond the left side of the roller table, and their right or rear ends extend beyond or to the right of the vertical columns an equal or preferably a somewhat greater distance from the uprights, and well beyond the right end of the base, so that the base in no way interferes with an operator who may be loading articles onto the shuttle table. The beams **40** are connected at the right or rear ends by a cross channel **41,** and there are cross braces **42** (FIG. **11**) extending between them intermediate their ends. There may or may not be a cross bar **43** at their forward or left ends, but there must be an open space between them at the left or forward end greater than the area of the pallet.

Each of these side beams **40** has a vertically-extending side plate **44** secured to the outer face thereof at the location where the beams pass through the upright frame (see FIGS. **12, 13** and **14**), these plates being interposed between the vertical columns of the upright frame and the beams. As best seen in FIG. **12,** each sprocket chain has one vertical reach attached to a lug **45** carried on the adjacent side plate near the top of the plate, and the same reach is attached to a lug **46** near the bottom of the side plate. In fact the two ends of the chain end at these lugs **45** and **46** and the side plate comprises the connecting link between the chain ends. It is through these connections that the cross frame is moved up and down in the vertical frame when the chain is driven one way or the other.

To keep the cross frame free of tipping and level at all times, the drive chains are not only of even effective length and are driven in isochronism, but the side plates are guided by smooth, free-running engagement with the vertical columns **25** and **26.** As here shown, this guiding and steadying arrangement is effected by at least three rollers on the outer face of each side plate **44.** These rollers **47** are so arranged that the top and bottom ones roll against one of the inside flanges of the vertical column which they confront and the intermediate one rolls against the opposite flange. This staggered arrangement is clearly shown in FIG. **14,** so that the cross frame comprises a vertically-movable cantilevered truss structure. Each of the flanges of the columns **25** and **26** has a vertical bearing strip or track **48** on the inner face of the flange against which the peripheries of these rollers bear (see FIGS. **12** and **13**), this track being shown broken away in some figures for clarity of

illustration. In addition to having their peripheries to hold the platform level, the rollers **47** have shoulders **49** that bear against the outer edges of the rails **48** to prevent side sway of the cross frame structure.

To provide necessary adjustment and take up for wear, each roll is carried on its shaft **50** that passes through a hole **51** eccentrically positioned in a circular block **52** (See FIG. **15**) set in the side plate **44**. The outer end of this shaft is threaded and has a retaining nut **53** thereon, while the block is clamped in position by keeper-lugs **54** bolted to the side plates, and which extend over a shoulder around the circular blocks. By loosening these lugs and rotating the blocks, the working contact of the roller peripheries against the track strips **48** can be established and adjusted as required, and by means of the nute **53,** endwise adjustment of the roller shafts can be made.

THE SHUTTLE TABLE

As best seen in FIG. **12,** each side beam **40** has an angle bar **55** secured to its top flange, one leg of the angle bar being vertical and the other one, resting on the beam **40,** being turned outwardly. Secured by bolts providing stud shafts therefore are a series of spaced rollers **56** along the inner face of the vertical legs of the angle bars **55.** The peripheries of these rollers project above the top edges of the angle bars on which they are carried. This series of spaced rollers, like the angle bars **55** on which they are carried, extend along substantially the full lengths of beams **40.**

The shuttle table **6** comprises a rectangular rigid metal plate **60,** which, as shown in FIG. **12,** has its opposite longitudinal marginal edge portions resting on and supported by the rollers **56** so that the table may move freely lengthwise along the cross frame. There are guide strips **61** on the under side of the plate that will engage the top edges of the rollers to guide the table in its back-and-forth travel along the cross frame. The table preferably has a length greater than half the length of the cross frame on which it travels, since, as seen in FIG. **5,** it reaches from the vertical columns **25** and **26** to the rear or right end of the cross frame when it is in retracted position. There are stop members **62** on cross bar **41** at the end of the cross frame at a level where it will limit the rearward movement of the shuttle table, and there are upright abutments **53** (see FIGS. **5** and **13**) at the forward or left ends of the angles to limit its travel in the forward direction. The table, which is normally wider than the pallet to be loaded, has longitudinally-extending side guides **54** secured to the top thereof, each parallel with, but spaced inwardly from the adjacent side edge of the table to define the maximum width of the load, which is usually less than the width of the pallet, and all objects to be loaded are placed in the flat area of the shuttle table between these load guides. As indicated in FIG. **13** these guides may be bolted to the table so that limited adjustment of the distance between them for variation in load widths may be provided, as indicated at **65.**

As best seen in FIG. **12,** there is a cross bar **66** suspended by a double spring suspension with center bolts **67** at each end from the lower flanges of the beams **40,** this bar being located under the shuttle table near its forward or left end. It supports bearings **68** for a cross shaft **69** near opposite ends of which are friction wheels **70.** A reversible electric motor and reducing gear assembly **71** at the middle of the cross shaft **69** drives the shaft. The underside of the plate **60** forming the shuttle table **6** rests on these friction wheels, so that when the friction wheels are driven in one direction or the other, the table is driven forward or backward, as required. The drive, however, is a friction drive, and the shuttle table is kept on the friction wheels and the rollers **56** only by its own weight. The spring suspension elements **67** are adjusted to provide the desired frictional contact of the wheels **70,** which have suitable friction tires, with the table.

As hereinafter more fully pointed out, this friction drive arrangement is an important safety factor and the fact that it is positioned entirely under the shuttle table gives operators full freedom of access to the table for arranging the successive layers of objects where one layer will "break joints" with the one beneath.

THE RESTRAINING BAR ARRANGEMENT

A cross bar **75** extends between the upper portions of the side plates **44** of the cross frame (FIG. **12**). Depending from it are two spaced arms **76.** There is a shaft **77** extending crosswise of the machine between these two arms with its ends supported in the lower ends of the arms. Around this shaft there is a sleeve **78** having two parallel levers **79** attached thereto near its opposite ends. The restraining bar **80** itself, is secured to the lower ends of these levers, and it is long enough to extend most of the distance between the load guides **64** on the table when this bar is in its lower load-restraining position shown in FIG. **12.**

The sleeve **78** also has a pair of closely-spaced lever arms **81** extending therefrom at an angle to the levers **79** and located near the center of the sleeve. A piston rod **82** forming a part of a fluid pressure cylinder and piston unit **83** extends between the arms **81** and is pivotally connected thereto. As best seen in FIG. **11,** there is a frame structure bolted to the underside of the center of the cross bar **75** comprising rigid parallel structural bars **84** with upturned ends **85,** the tops of which are joined by cross piece **86.** This structure provides a bracket with the cylinder-piston unit **83** positioned between its two side parts **84–85,** and with the upper end of the cylinder pivotally anchored at **87** to a lug **88** on the underside of cross piece **86.**

With this arrangement, when the piston rod **82** is fully extended by the admission of fluid pressure to the upper end of the cylinder, the restraining bar **80** is in the elevated position well above the shuttle table, as shown in full lines in FIG. **11,** but when fluid pressure is admitted to the lower end of the cylinder, retracting the piston rod, the sleeve **78** is rotated to swing the restraining bar down through an arc of about 90° or preferably perhaps a little past 90° to the dotted line position shown in FIG. **11.**

Since the cross frame is moved up and down, air pressure for operation of the cylinder-piston unit **83** is supplied from a connection **90** on the base through a flexible hose **91** to a connection box **92** secured to one of the beams **40.** A tube **93** leads from this box to a switch valve **94**(FIG. **11**) where this valve is closed by a contact shoe **95** on the underside of the rear of the table. In this position pressure air flows through the valve and along tube **96,** which, as shown in FIG. **12,** leads to the top end of cylinder **83.** At this time a second switch valve **97** will vent the lower end of the cylinder to atmosphere. When the table has moved all the way forward, the shoe **95** will operate switch **97** to vent the

upper end of the cylinder **83** and supply pressure through line **98** to the lower end of cylinder **83** to retract the piston in said cylinder and swing the restraining bar down. It will then stay down until the shuttle table has retracted and the shoe **95** operates valve **94** to vent the lower end of the cylinder and restore pressure to the upper end.

Pneumatic valve circuits of this type are well known in the art and form no part per se of the present invention. The two valves **94** and **97** are so interconnected that when one is admitting fluid pressure to the cylinder, the other vents the opposite end of the cylinder, but at intermediate times the pressure is held in the end of the cylinder to which pressure was last applied.

In most cases, one plant or one apparatus will be employed for one standard load of objects, so there is provided an indicator to show the operator the levels at which loads are to be placed. It comprises a removable panel **100** on the upright column **25.** This is shown in FIG. **10** where the panel has a key slot **101** near its lower end that engages a stud on the face of the column that is turned toward the loading end. There is a similar key slot and pin at **102** at the top of the panel (FIG. **9**). The panel has markings **103** thereon, preferably comprised of strips of colored tape with a pressure-sensitive adhesive to removably hold them on the panel to indicate the levels at which loads are to be placed on the pallet. An indicating pointer **104** on the adjacent cross-frame side plate **44** will indicate the level to which the cross frame is to be moved. When the character of the load is changed, the panel may be removed, the tape markers relocated, and the panel replaced.

Power for the reversible motor **71** on the cross frame is supplied through a flexible cable **105** leading from an outlet box on the base to a connecting box **106** on the underside of the cross-frame.

All of the elements to carry out the operations outlined in FIGS. **1** to **4** have been described. It is only necessary to provide switches to operate the reversible motor **30** to bring the cross-frame with its shuttle table to the right or home level for loading, then, after the load is placed on the table, again operate the motor **30** to raise or lower the cross frame to the level just above the level of the surface on which the next layer of objects is to be placed on the pallet. After the cross frame has been so raised or lowered, the reversible motor drive **71** is then operated to drive the friction wheels in a direction to move the shuttle table to the left as far as it will go against stops **63,** and the friction drive can drive it no further. The restraining bar will lower at this time and the motor **71** is reversed to bring the table back to its starting position, stripping the load from the table onto the pallet or the previous load on the pallet, as the case may be.

While this sequence of operations may all be effected manually through the operation of successive switches, it may be so arranged that all operations will proceed automatically through a full cycle. This has not been fully shown, but certain parts of the circuitry is shown.

ELECTRIC CONTROLS

There is an electric control box **110** mounted on the outside of the column **25** at a convenient height above floor level (see FIGS. **9** and **10**). Should it be more convenient, the panel **100,** indicators **103** and control box **110** could of course be located on the opposite column **26.** The control box has several buttons on one side, the uppermost one designated **111** being pushed to connect the apparatus to a source of operating current, being an "on" button. The next one, **112,** below and to the left as viewed in FIG. **10,** is to operate motor **71** to move the shuttle table on the cross-frame from the retracted or load-receiving position to its extended position, and the third button, **113,** is pressed to reverse the shuttle table and return it to the retracted or load-receiving position. Below the three buttons just described are four others in a vertical row. The uppermost of these, **114,** is operated to move the cross-frame up. The next lower one, **115,** controls the down movement of the cross-frame. The next lower one, **116,** is an automatic cycle switch, and the lowermost one, **117,** is an emergency stop that may be pressed to instantly stop the machine at any point in its operation until the start or "on" button **111** is again pressed.

As best seen in FIG. **14,** the side of one of the columns, in this case column **25,** there are three limit or flag switches close together, the center one of which, designated **120,** is at the "home" or loading level of the cross-frame. The one immediately above, **121,** is an "up" switch that functions on automatic cycle of the machine to cause continued upward travel when button **116** is pressed after initial pressing of "up" button **114.** The lowermost one, **122,** continues the downward travel on automatic cycle when the button **116** is pressed following operation of the "down" button **115.** These switches **120, 121** and **122** are operated by an actuator or contactor **123** projecting from the side face of the confronting cross-frame side plate **44.** In addition there is a lower limit switch **124** spaced below switch **122** which will be operated when the cross-frame has been lowered to the lowest point of its travel, which is a level at which the shuttle table **60** will just clear the top of a pallet on the roller table.

There is a limit switch **125** adjustably positioned on the column **25** at a predetermined level above the home position corresponding to the maximum height to which the load on the pallet is to be raised (see FIG. **9**).

Referring particularly to FIG. **11,** there is a cable **126** extending from the electric outlet box **106** on the cross-frame to a limit switch **127** adjacent the pneumatic switch **94** arranged to be operated by the shoe **95** to stop the motor **71** when the shuttle table is fully retracted and set a reverse switch which will cause it to drive the table forward when the circuit to the motor is next energized. A cable **128** leads from outlet or junction box **106** to the motor. Another cable, **129,** leads from the junction box to a limit switch **130** located adjacent the pneumatic switch **97** for operation by the shoe **95** when the shuttle table is fully extended for stopping the drive motor **71** and reversing the circuit when the motor is next energized. These switches and this circuitry is a known type of circuit in other environments.

In addition there is included in the motor circuit, not as an essential element, but as an added safety feature, a pair of switches **131** and **131*a***, one of which, **131,** is at the forward end of the shuttle table and will operate to stop motor **71** if the shuttle table should move forward at a level where it strikes the previously-deposited load, and the other one, **131*a***, is on the underside of the shuttle table to de-energize both motors if the cross-

frame and shuttle table are moved down against the load before the shuttle table has retracted.

Also there are shown two electric eye circuit control units carried on the cross-frame at the forward end over the roller table area (see FIG. **13**). One of these comprises a light projector **135** that projects a light diagonally to a photo-sensitive receiver **135***a*. The arrow between these elements in FIG. **13** represents the light beam. This circuit is broken when the light beam is interrupted and controls the motor **71** so that it will not operate if there is an obstruction to the light beam at any level. Consequently the cross-frame must be at a level above the previously-deposited load on the pallet before the shuttle table drive can operate to propel the shuttle table forward. It is, however, slightly below the bottom of the shuttle table, so that as the shuttle table moves forward, it does not break the light path.

The other electric eye unit comprises a light projector **136** and photo-sensitive receiver **136***a*. This is arranged on the opposite diagonal to the first, the arrow extending between them representing the other light beam. The circuit for this unit is closed when the light beam is broken, and open when the light beam is not interrupted. It controls the cross-frame raising and lowering motor **30** so that the cross-frame will raise the cross-frame only so long as there is a load between the cross-beams so that it will raise above any load and stop when the light beam is completed, indicating that the cross-frame is at a level where the shuttle table is clear of the load and needs to be lifted no higher.

OPERATION

In operating the machine, the cross frame will always at the start be at the home or loading level. Since the pallet will be empty, the operator knows that the cross frame must go down from the home position until the load on the pallet is at or above the home level. Assuming that the operator is loading parallelipiped objects, such as cartons or cases, he will have been provided with a loading pattern so as to break joints in successive layers or courses on the pallet. He will arrange the first layer on the shuttle table according to pattern between the side guides **64** back of the forward edge of the table, preferably roughly in back of the plane of the raised position of the restraining bar **80.** In the direction of the length of the table, it does not matter if the articles are not closely spaced when initially put in place because they will be shoved and crowded together when the shuttle table pulls back and the restraining bar holds the load.

The operator, after arranging the first layer, and knowing that the cross-frame must go down, and assuming the "on" button **111** to have already been pushed, now pushes the "down" button **115.** Under manual control he holds this button in until the cross-frame reaches its lowermost position. Limit switch **122** prevents the cross-frame from moving too low. He may then push button **112** to drive the shuttle table forward, and at this level it will be a slight distance, an inch or so above the level of the pallet. When the shuttle table has been moved to its full limit forward, or to the left end of the cross-frame as here illustrated, the air valve **97** will be operated by shoe **95** to swing the restraining bar down to the dotted line position, as described. At about the same time switch **130** will open the circuit to the table-driving motor **71.** Then the operator will push button **113** to retract the table to deposit the load on the pallet. The distance between the restraining bar and the forward edge of the shuttle table in the extended position is such that for a standard pallet and layer of objects, the table will draw back a few inches and the first objects will be dropped by the withdrawing table just at the left-hand edge of the pallet, since the load is usually flush with the edges of the pallet. When the shuttle table has fully retracted, the switch **127** will operate to stop the motor **71,** and pneumatic valve **94** will raise the restraining bar. The operator may then push the up or down button as may be required to bring the cross-frame down to the home or loading level at which level limit switch **120** will operate to stop motor **30.** This motor is of the self-braking or automatic type so that there is no overtravel when it is de-energized, and motor **71** is also preferably of the self-braking construction, such motors being well known in hoisting apparatus. After one layer of objects has been loaded onto the pallet and the cross-frame has been returned to loading level, the operator arranges another load on the shuttle table and the operation is repeated until such time as the load level becomes higher than the home or loading level. When this load height is reached the operator pushes the "up" button first.

After the last layer of articles has been placed on the now fully loaded pallet, the cross-frame with the shuttle table will be raised clear of the load, after which the stop **21** (FIG. **8**) will be raised clear of the pallet to enable it to be rolled off the roller table. Should there be no switch **131** on the shuttle table, or should it not operate, and through some error the shuttle table would move forward and strike the load, the cross bar **43** would prevent displacement of the load, since it would always be opposite and slightly below the plane of the shuttle table. After the shuttle table hits the load and loses its inertia, the friction drive for the table will slip and no damage to the load will occur.

CONTROL CIRCUIT DIAGRAM

The essential elements of a circuit to effect operation are disclosed in the diagram (FIG. **16**). Automation of these controls to carry out a complete cycle after a "start" button has been pushed is simply a matter of adapting relays and electric eye circuits to open and close the switches of this diagram, or relays in parallel with them.

In FIG. **16** the motors **30** and **71** are connected across power supply lines L1 and L2. These motors are controlled through reversing relay switches **30***a* and **71***a*, respectively. The control circuits are energized by a step-down transformer T having its primary connected across lines L1 and L2. The secondary has one side connected to a common return, indicated by the "ground" symbol and the other side to the line **164,** through relay operated emergency "off" switch **117***a* which is normally closed, but which is opened by operating push button switch **117** on the control panel. From **117***a* the connection to line **164** includes the manually-operated "on" switch **111** that energizes the entire control circuit. This switch will remain closed until pushed again to open the circuit. One terminal of each of the reversing relays **30***a* and **71***a* is connected as indicated by the ground symbol to the common return. Line **164** leads to flag switch **116** at the "home" or loading level. For simplicity this switch is here shown as one which is biased by springs to return to a neutral middle position after the flag has been moved up or

stud there is a bell-crank **249** that is pivotally supported on the stud. It has a long arm **250** and a short arm **251.**

There is a fluid pressure cylinder and piston unit **252** pivotally supported at **253** on a second mounting block **254.** The block **254** is bolted to the plate **44,** and there are two parallel rows of holes **255** so that the block **254** may be adjustably secured in position according to the position of the mounting block **248.**

At the outer end of the long arm **250** of the bellcrank there is an extension **256** that is pivoted at **257** to the end of the long arm. As shown in FIGS. **19** and **20** the arm **250** and the extension **256** have overlapping half-thickness portions **250***a* and **256***a*, respectively, through which the pivot pin **257** passes. Extension **256** is beveled at **256***b* to limit the free swing which the extension has on pivot **257** relative to the long arm **250.** The joint is a "knee-joint" which does not permit the extension **256** to swing past an aligned position with respect to the long arm in an upward direction and can drop only through a limited arc less than 90° downward from a straight line position. The arm **250** with the extension **256** is in effect a toggle lever which increases slightly in length as the arm **250** swings down to a horizontal position parallel with the top of the shuttle table. When the arm reaches such horizontal position as shown in FIG. **18,** the section or extension **256** rests on a supporting projection or pin **258.**

The restraining bar itself is designated **259** and extends over the path of travel of the shuttle table. When it is lowered to the position shown in FIG. **18** the thrust of the object O resting on the shuttle table which is retracting against the restraining bar **259** is horizontal and is transmitted horizontally through the composite arm directly against the studs **248***a* of the two mounting blocks **248.** When the restraining bar is in this position thrust cannot be exerted in a direction where it may rock the bell-crank on its pivot so that the cylinders **252** require little more than sufficient pressure to raise or lower the compound lever arms **250–256** and the restraining bar **259.** A series of holes **258***a* in each plate **44** enables the support **258** to be raised or lowered as the block **248** is raised or lowered.

The restraining bar, which is here shown as being of round cross-section, may be square or rectangular, depending on the load to be engaged. The arm extension **256** at each side of the machine has a series of regularly-spaced holes **260** therealong. The restraining bar **259** can be adjusted toward or away from the pivot **257** at each side of the machine by a bolt that passes through one of the holes in the extension **256** into the restraining bar at a selected hole **260.** The further back the restraining bar is set toward the pivot **257,** the greater will be the delay in pushing the object or objects O from the shuttle table moving in the direction of the arrow to the retracted position. This is important where the load on the pallet is to overhang the pallet or is to be smaller than the pallet.

Adjustment of the height of the restraining bar is desirable, depending on the character of the load. With taller cartons, for example, it may be desirable that the restraining bar engage the cartons at a higher level.

Many times cartons are stacked on pallets with cover flaps that are only partially closed, the flaps being angled upwardly at various angles between about 30° and 45° or even more from the horizontal. Using the apparatus herein described on an automatic cycle, one electric eye system comprising elements **136** and **136***a* will effect the stopping of the upward travel of the vertically-movable frame when a light path is clear from one element to the other, whereupon the shuttle table will be advanced over the previously-deposited cartons with the partially open flaps. When the shuttle table reaches its furthest forward position the circuit for moving the restraining bar into operative position will also energize a timer that will lower the cross-frame enough for the underside of the table to press down on the partially-open flaps of the cartons beneath and substantially close them. Then the shuttle table is retracted to deposit the next layer of cartons.

A difficulty with this arrangement is that the electric eye system merely senses when it rises above the cartons already on the pallet, but cannot sense whether the flaps are open a little or a lot and the timer lowers the frame a fixed period of time which may result in more pressure being applied than is wanted and the retracting movement of the shuttle table from which its load has not been discharged may drag on the top layer of cartons already in place and even disturb the entire load.

In FIGS. **21** to **24** there is disclosed a means for avoiding this objection. Assuming that the control box and limit switches are on the vertical frame column **25,** this modification discloses a bar **270** extending up along one side of the other column **26.** It is supported on at least two brackets **271** and extends from a distance slightly above the home level to near the top of the frame. The brackets **271** have slots therein with set screws **272** for securing the bar to the brackets in such manner that the bar may be adjusted vertically relatively to the brackets.

The bar **270** has holes **273** therein at regular intervals, preferably about an inch from center to center. Pins or pegs **274** are removably set in these holes at regularly-spaced distances. If the cartons with the flaps folded down are about **12** inches in thickness, these pins, **274,** will normally be on **12**-inch centers, but if the cartons are thicker, they will be placed further apart, and for thinner cartons closer together.

On the underside of the transverse frame, as for example on the bottom flange of one of the side frame sections **40** there is a flag switch **275** that will ride past the pins or pegs **274** when the cross-frame is moving up, but will be operated by contact with the first peg it encounters on the way down to stop the travel of the cross-frame.

The sequence may be followed by reference to the block diagram in FIG. **4.** Current supplied through line **276** and the ground drives motor **30** upwardly as long as no light flows between elements such as **136–136***a* (FIG. **13**) and electric eye control unit **136***b*. When light passes between the elements **136–136***a*, indicating that the elements have been raised above the stack on the pallet with the last layer having upturned flaps, motor **30,** which is raising the frame will be stopped. At the same time current will flow through line **277** to drive shuttle table motor **71** in the forward direction. When the shuttle table has been driven forward to the extended position, switch **130'** will open to stop motor **71** and current will flow through line **278** and timer **279** to flag switch **275** to the reverse lead of motor **30.** This will start lowering the cross-frame. When either flag switch **275** is opened by contact with a peg **274,** or the timer opens the circuit, the operation of motor **30** will

down, in which position it closes a circuit through line **169** to manual "up" switch **114** which is in series with normally closed upper limit switch **125** and relay switch **114***a*. One terminal of switch **114***a* connects through line **114***b* with the "up" terminal of reversing switch **30***a*.

When manual "up" switch **114** is closed, it first energizes magnetic switch **114***c* to close this switch, whereupon the motor **30** will be operated to raise the cross-frame as long as the manual switch is held closed, but if the frame should by chance go too close to the top of the upright, limit switch **125** would open the circuit and close it only if the cross-frame started to lower.

There is a branch line **170** from line **169** that leads to one terminal of manual "down" switch, which is in series with normally closed bottom limit switch **122** and relay or magnetic switch **115***a*, the second terminal of which leads up through line **115***b* to the "down" terminal of reversing switch **30***a*. When the manual "down" switch **115** is closed, switch coil **115***c* will first be energized to close switch **115***a* and the cross frame motor **30** will then be energized to lower the frame. If the cross-frame starts down or is below the home position, limit switch **122** will be operated to open the circuit if the cross-frame should be lowered below its normal operating range. When the cross-frame travels down from its up position above the home switch **120** or up from below that switch, it will momentarily open switch **120** even if switch **114** or **115** is held closed, breaking the circuit through coil **114***c* of switch **114***a* or coil **115***c* of switch **115***a* to stop the travel of the cross-frame at this level. Flag switches **121** and **122** are shunted around switch **120** to be operated after the vertical frame moves up or down past home position both for automatic operation and to prevent a condition that would arise if the switch **120** should be in an "off" position due to slight overtravel.

Line **164** also leads to one terminal of switch **112** which is the manual switch for operating motor **71** to propel the shuttle table to the left from its retracted position, so that when the switch is pushed closed, a circuit will be completed through this switch to line **112***a* and normally closed limit switch **130** to line **130***a* to operate motor **71** until the shuttle table at its forward limit of travel opens limit switch **130** to stop it. When manual switch **113** is closed, a circuit will be completed through line **113***a* to normally closed limit switch **127** to line **127***a* to operate the motor **71** in the reverse direction to retract the shuttle table until limit switch **127** is opened by the shuttle table reaching its fully retracted position.

As before mentioned, there may be two safety switches **131** and **131***a* on the forward end of the shuttle table **131** to be actuated if the shuttle table should inadvertently be moved forward when the cross-frame was not high enough for the shuttle table to clear the load. This switch is schematically indicated in the diagram in line **130***a*. It is normally closed, but upon the forward edge of the shuttle striking a previously-positioned load on the pallet, it will open line **130***a* and stop the motor **71**. Switch **131***a* on the under surface of the shuttle is arranged to contact the top of the load, should the table and cross-frame be inadvertently or accidentally lowered onto the load on the pallet. It is connected from line **164** to the emergency "off" relay **117***a* in parallel with emergency off switch so that operation of either switch **131***a* or **117** to closed position will open the circuits that control both motors.

The fundamentals of a circuit for manual or semiautomatic operation of the machine have been here indicated for completeness of disclosure. To automate these circuits to perform in the manner hereinbefore described with electric eyes to control up and down travel and switches to raise the crossframe clear of the load on the pallet after the last layer has been deposited, involves only conventional relay circuits which form no part of this invention, and which have therefore not been shown or described, except some elements have been included to indicate the capability of so adapting the machine to a system where, after the operator has placed a layer of articles on the table, the pushing of one button will complete the full cycle of bringing the cross-frame to the proper level, depositing the articles on the pallet and returning the cross-frame to the home position.

As shown in FIG. **10**, limit switch **125** is vertically adjustable, which is desirable for automatic operation, but for manual operation it may be fixed, or duplicated as at **125***a* in FIG. **9**.

While the apparatus as above described has been successfully used in commercial applications, the restraining bar **80** in its lower or operating position is at the end of lever arm **79** on the sleeve **78**, which, as explained above, is operated by fluid pressure cylinder **83**, piston rod **82** and crank arm **81**. The thrust against the bar, particularly with heavier crates or cartons is exerted therefore through an unfavorable leverage, requiring high pressure in the cylinder **83** to hold the bar steady when the shuttle table is retracting and the load is being pushed off. Any slight yield that allows the restraining bar to delay in starting the discharge of a load onto the pallet results in the layer being improperly positioned.

In the modification shown in FIGS. **17** to **20** inclusive there is an arrangement wherein the restraining bar is on dead center with the axis about which it pivots when it is in load-restraining or obstructing position so that the thrust is exerted in the direction of the length of the lever on which it is carried and resisted in the studs about which the arms rotate so that only moderate pressure is required in the operating cylinders for moving the restraining bar into and out of load-obstructing position. Also the levers on which the bar is carried are articulated intermediate their ends in such manner that the bar is thrust forward in the direction of the load to a slight extent as it moves into operative position and retracts as it lifts from such position.

In FIGS. **17** to **20** I have shown the mechanism at one side only of the machine and it is duplicated on the other side. The side plate **44** corresponds to side plate **44** of FIG. **5**, and **26** is one of the upright columns. There is a structural section **75** extending across the machine connecting the tops of the side plates **44**, as in the structure previously described.

The plate **44** has two vertical rows of equally spaced holes therethrough at **247** and a mounting block **248** is secured to the inner face of the plate **44** by bolts (not shown) passing through the mounting block and side plate **44** and fixed with nuts (not shown). This enables the mounting block to be fixed at selected levels, so that its position is adjusted to the load being handled. The mounting block has a fixed stud shaft **248***a* projecting therefrom toward the center of the table. On the

be stopped. This will assure of the flaps on the boxes being pressed down by contact with the underside of the shuttle table, but by proper setting of the pegs and proper adjustment of bar **270** in its brackets, the pressure on the flaps will be insufficient for the cartons to drag against or be dragged by the shuttle table as it now starts to retract. Various conventional circuits, either in the nature of time delay relays or other relays responsive to the opening of the circuit through line **278** may be used for further sequencing the operation.

The apparatus has a base structure that covers very little floor area and with the upright frame comprised of two parallel upright columns, one at each side of the base, both end areas of the vertically-movable horizontal frame with its shuttle table are easily approached from three directions without interference from obstructing columns, at each corner, as is the case with so many different loaders. Also, since it is necessary in making a safe load, to break joints at different levels, the loading end of the shuttle table of the present invention is accessible so that an operator may lean across it in arranging succeeding layers in different patterns of the same overall dimensions. The vertically-movable elongate horizontal frame has the two side members **40** spaced with a clear opening between them so that the elongate frame may be lowered to a level where its open end straddles the pallet placed on the pallet support and when the frame is so lowered the horizontally-movable shuttle table will be at a level to just clear the top of the pallet so placed. Once the load has been built up on the pallet to the home level it is protected from being toppled over by the side rails **40** at each side and by the cross rail **43.** This is an important security feature because careless load arranging or placement must be guarded against. Only when the last layer has been placed on the pallet is the cross-frame raised above the load after it has reached a height of more than a few courses.

The friction drive for the shuttle table is also an important safety feature, as hereinbefore pointed out. Others have attempted to use fluid pressure cylinders to move a load-carrying table from one position to another but such cylinders exert a positive force that is difficult to control if the shuttle table should be prematurely projected forwardly, or even withdrawn, whereas the friction drive made possible by applicant's invention provides for slippage where an otherwise serious impact could occur. In addition the shuttle table may lift off the cross-frame and the friction drive wheel **70** will be ineffective to exert sufficient force to the shuttle table to cause damage. The reversible friction drive for the shuttle table as here described is therefore an important safety factor, especially under manual operation. While it is indicated that only a single layer of objects may be placed on the shuttle table and transferred to the pallet, there may be two or three layers placed on the shuttle table, one above another, when the objects are relatively thin and relatively light. The trolley elements at each side of the elongate frame with a vertical series of laterally-adjustable rollers working between the flanges of the structural columns **25** and **26** provides for the smooth up-and-down travel of the elongate frame while holding it horizontal and restraining it from "see-sawing". These and many other advantages are secured by the apparatus, as will be apparent to those familiar with material handling.

While the apparatus has been described specifically for loading pallets, it may be used in loading objects onto supports that are strictly not pallets. The base may be provided with wheels or rollers to make it movable, so that in place of loading pallets it may stack objects in warehouse bins, or possibly freight cars and trucks, and by placing the rear end against an elevated platform, the apparatus may be used to transfer articles from a higher level and arrange them in piles at a lower level, or place them on conveyors so that the "home" position in this case could be quite high. However, even if its utility were confined to its primary purpose, its use will speed up pallet loading in many industrial environments and substantially reduce the manual labor involved in this operation.

The four-way valve system that controls the operation of the cylinder **83** for the restraining bar **80** in FIGS. **1** to **16** is also used for controlling the operation of the two cylinder and piston units **252** for the restraining bar arrangement in FIGS. **17** to **20.** Also there may be times when the last layer or tier of objects or cartons placed on the load must be kept quite steady when the next layer is being put in place. This is particularly so where the cartons are small and the upstanding cover flaps must be flattened down in the manner above described before the succeeding layer is put in place, because even a slight drag of the cover flaps against the underside of the retracting shuttle table may displace some of the cartons.

My invention may provide means for holding the cartons of the top layer firmly in place at such times. As shown in FIG. **13,** a pair of fluid pressure cylinders **285,** preferably air operated, are mounted on the cross-frame **42** of the elongate frame. Pivoted to the terminals of the pistons for these cylinders is a bar **286** which is of a length nearly the width of the layer of objects on the load and a level below the plane of travel of the shuttle table and an inch or two more or less below the top of the cartons or objects in the uppermost tier when the elongate frame is at a level to deposit the next layer of articles on the load.

There may be a similar bar **287** with fluid pressure cylinders **288** at the same level on cross bar **43** at the forward end of the elongate frame.

When the valves **95–97** are operated to move the restraining bar into position, pressure air is also admitted to these cylinders **285** and **288** to move the respective bars **286** and **287** against the objects on the top tier of the load and hold them steady until the placing of the next load is complete and when the restraining bar is raised, the same operation will operate cylinders **285** and **288** to retract their respective bars **286** and **287** so that the elongate cross frame may again move up and down free and clear of the load on the pallet. A stroke of a couple of inches for moving the bars **286** and **287** is all that is required.

In many cases it may be desirable to clamp the upper tier on four sides, instead of two, and in this case, as shown in FIG. **13,** there may be movable side rails **289** and **290** at the same level as **286** and **287.** They are similarly arranged to be operated by fluid pressure cylinders **291** and **292** respectively. They of course are in the same pneumatic circuit as the others to operate in conjunction with them.

I claim:

1. Apparatus for stacking articles on pallets which comprises:

a. a base structure with a pair of spaced parallel upright columns thereon and having a pallet support at one side of the columns on which a pallet is placed for loading,

b. an elongate frame supported between its ends for movement upwardly and downwardly on said columns, the elongate frame having a loading end and an unloading end at opposite sides of said columns, the unloading end being positioned over said pallet support, the elongate frame having side frame members spaced to clear the two opposite sides of a load being stacked on a pallet placed on said support, and cross members connecting the side frame members and spaced to clear the other two sides of the load being so stacked, the side frame members and cross frame members defining an opening at the unloading end of the cross frame so arranged that the side members and cross members may surround the uppermost portion of a stack being arranged on a pallet, the pallet support being centered under said opening,

c. a load-transferring shuttle table above and supported on said elongate frame and movable back and forth over the elongate frame between a retracted load-receiving position at the loading end of said frame and an extended position over the unloading end of said frame,

d. a load-restraining means supported on the elongate frame intermediate its ends movable between a raised position over said elongate frame where it is clear of any load being carried on the shuttle table from the receiving end of the elongate frame toward its extended position and a lowered position where it restrains movement of a load on the shuttle table when said shuttle table is moved from the extended position over said elongate frame to the retracted position,

e. means for controllably raising and lowering the elongate horizontal frame,

f. means for controllably moving the shuttle table back and forth on said elongate frame,

g. means for controllably moving the restraining means between its raised position and its lowered position, and

h. stack-supporting means on the frame movable in the area of said opening to engage the uppermost portion of the stack being formed on the pallet and brace it when the shuttle table is moving from its extended position back from the unloading end of the frame toward the loading end.

2. Apparatus for stacking articles on pallets as defined in claim **1** wherein the said opening at the unloading end of the elongate frame at its lowermost limit of travel on said columns is arranged to surround a pallet which is placed on said pallet support and the shuttle table is then at a level where it may move over and clear the top of a pallet so positioned, said means for controlling the raising and lowering of the elongate frame comprising:

a. a reversible electric motor and means driven thereby for raising and lowering the elongate frame,

b. a flag switch arranged to stop said motor whether the frame is moving up or down at a home position intermediate the lowermost and uppermost limits of travel of the frame at a level convenient for arranging a load on the shuttle table, and

c. control switches for selectively moving the elongate frame downwardly or upwardly from said home position.

3. Apparatus for loading articles on pallets as defined in claim **1** wherein said stack-supporting means on the frame movable in the area of the opening is a load-engaging member reciprocable in the direction of the length of the elongate frame at a level to engage the uppermost tier of articles on the stack across substantially the entire width of the stack, and means for moving said member toward the stack when the shuttle table is about to place additional articles on the stack and retract it after said additional articles have been placed on the stack.

4. Apparatus for loading articles on pallets as defined in claim **3** in which there is a second such supporting member on the elongate frame opposite the first in a position to move into and out of position to confine the articles on the top tier at the side of the load opposite the side which is contacted by said first member, and means for moving the second member into and out of article-engaging position simultaneously with the first.

5. Apparatus for loading articles on pallets as defined in claim **4** in which fluid pressure cylinders operate said two members in unison.

6. Apparatus for loading articles on pallets as defined in claim **4** in which there are two other such supporting members on the elongate frame for engaging the said top tier of articles on the two sides at right angles to said first two members and similarly movable toward and away from the top tier but at right angles to the direction of movement of said first and second support members.

7. Apparatus for stacking articles on pallets which comprises:

a. a base structure with a pair of spaced parallel upright columns thereon,

b. an elongate frame supported between its ends for movement upwardly and downwardly on said columns, one end of the elongate frame at one side of the columns being a loading end and the other end at the other side of the columns is an unloading end,

c. a load-transferring shuttle table above and supported on said elongate frame and movable back and forth over the elongate frame between a retracted load-receiving position at the loading end of said frame and an extended position over the unloading end of said frame,

d. a load-restraining means supported on the elongate frame intermediate its ends movable between a raised position over said elongate frame where it is clear of any load being carried on the shuttle table from the loading end of the elongate frame toward its extended position at the unloading end and a lowered position where it restrains movement of a load on the shuttle table when said shuttle table is moved in the reverse direction,

e. means for controllably raising and lowering the elongate horizontal frame,

f. means for controllably moving the shuttle table back and forth on said elongate frame,

g. means for controllably moving the restraining means between its raised position and its lowered position,

h. the upright columns being structural sections having a web with confronting spaced parallel flanges, said elongate frame having an upwardly-extending side plate at each side thereof along the outer face of which is mounted a vertical series of at least three rollers spaced one above another and adjustable horizontally with respect to one another, the rollers being so arranged that the upper and lower ones roll against one of said side flanges of a column and the intermediate one rolls against the other side flange whereby the elongate frame is held against tipping in either direction from a horizontal position but is easily movable up and down along said columns,

i. the sideplates having chains attached thereto through which raising and lowering thereof is effected, wherein said restraining means comprises two levers, each one pivotally mounted on one end to one said side plates, a restraining bar connecting the free ends of said levers, the levers being movable in a vertical arc from a position above the plane of movement of the shuttle table downwardly to a level where the restraining bar will contact articles on the shuttle table to restrain them from movement with the shuttle table, the arrangement being such that the restraining bar is on a horizontal dead center with the pivotal mountings of said levers on their respective side plates when the bar is in load-restraining position, there being a fluid pressure cylinder and piston on each said side plate for moving the respective levers simultaneously, said cylinders and pistons being arranged with respect to said levers that the piston of each is fully retracted into its cylinder when the restraining bar is in load-restraining position so that the piston cannot retract further when pressure is exerted against the restraining bar.

8. Apparatus for stacking articles on a pallet as defined in claim **7** wherein each of said levers is a toggle lever with first and second sections pivotally joined to each other and with one end of the first section being pivotally mounted on the side plate, the ends of the second sections of the two toggle levers being connected by a restraining bar extending transversely across the plane of travel of the shuttle table, said toggle levers each being straight from end to end when the restraining bar is in load-restraining position and the pivotal mountings for the respective toggle levers and the pivotal joint between the first and second sections of each is on dead center, the second section of each toggle lever being free to swing in an arc downwardly relative to the first section through a limited arc less than **90°** when the toggle levers are raised to move the restraining bar to its load-clearing position, and means for preventing said levers from swinging downwardly past said dead center position.

9. Apparatus for stacking articles on pallets as defined in claim **8** in which the pivotal mounting for said levers are arranged to be adjustably fixed on the side plates to be raised and lowered to adjust the height of said levers and the restraining bar relative to the shuttle table, and means for correspondingly adjusting the position of the respective fluid pressure cylinder and piston units as the pivotal mounting for the levers is adjusted.

10. Apparatus for stacking articles on pallets as defined in claim **7** in which the restraining bar is adjustable lengthwise along said levers to vary the position at which the restraining bars will be effective to begin removal of a load from the shuttle table when said table retracts.

11. Apparatus for stacking articles on pallets which comprises:

a. a base structure with a pair of spaced parallel upright columns thereon,

b. an elongate frame supported between its ends for movement upwardly and downwardly on said columns, and having a loading end and an unloading end,

c. a load-transferring shuttle table above and supported on said elongate frame and movable back and forth over the elongate frame between a retracted load-receiving position at the loading end of said frame and an extended position over the unloading end of said frame,

d. a load-restraining means supported on the elongate frame intermediate its ends movable btween a raised position over said elongate frame where it is clera of any load being carried on the shuttle table from the receiving end of the elongate frame toward its extended position and a lowered position where it restrains movement of a load on the shuttle table when said shuttle table is moved from the extended position over said elongate frame to the retracted position,

e. means for controllably raising and lowering the elongate horizontal frame,

f. means for controllably moving the shuttle table back and forth on said elongate frame,

g. means for controllably moving the restraining means between its raised position and its lowered position, and

h. a reversible friction drive for moving the shuttle table back and forth over the elongate frame and control circuits for effecting operation of said reversible friction drive at any level of the elongate frame between the lowest and highest positions thereof.

12. Apparatus for stacking articles on pallets as defined in claim **11** wherein there is an electric eye system arranged to stop the upward travel of the elongate frame when said frame is above the home position and is at a level where the shuttle table may move from the retracted position to its extended position and just clear the uppermost layer of articles on the pallet being loaded.

13. Apparatus for stacking articles such as cartons with partially-open flaps on pallets as defined in claim **12** wherein said electric eye system after stopping the upward travel of the elongate frame comprises means for effecting the operation of said friction drive to move the shuttle table to its extended position and means to effect limited downward travel of the elongate cross-frame with the shuttle table in such position, means for selectively positioning pegs at spaced intervals along the side of one of said upright columns, and means on said elongate frame arranged to engage one of said pegs when the elongate frame is then moving down to stop such downward travel when the partially-open flaps of the cartons of the last deposited layer have been closed by contact with the underside of said shuttle table in its extended position as the frame is lowered.

14. Apparatus for loading articles on pallets one layer at a time as defined in claim 11 wherein said means for controllably moving the shuttle table back and forth over the elongate frame comprises a friction wheel on the elongate frame bearing against the underside of the shuttle table and a reversible electric motor for driving said friction wheel.

15. Apparatus for loading articles on pallets as defined in claim 14 wherein the friction wheel is resiliently urged against the underside of the shuttle table.

16. Pallet loading apparatus and the like comprising:

a. a vertical frame with spaced upright columns,
b. an elongated cross-frame between the upright columns and supported for up-and-down movement in the columns,
c. the cross-frame comprising parallel spaced beams and having a rear end portion and a forward end portion, the space between the beams at the forward end portion providing an open area, the beams at each side of the frame having rollers at spaced intervals therealong,
d. a shuttle table suported on said rollers for back and forth movement along the cross-frame on said rollers between a retracted position over the rear end of the cross-frame to an extended position over said open area at the forward end of the cross-frame,
e. a restraining bar supported on the cross-frame intermediate the forward and rear end portions movable between an elevated position above the shuttle table to a load-obstructing position close to the top surface of the shuttle table,
f. means for raising and lowering the cross-frame,
g. means for moving the shuttle table between the retracted and extended positions,
h. means for moving the restraining bar between the elevated and load-obstructing positions,
i. a pallet-supporting means under the open space between the beams at the forward end of the cross-frame on which a pallet to be loaded may be removably centered, the open space between said beams at the forward end of the transverse frame being longer and wider than a pallet which said pallet-supporting means is designed to receive, whereby a load may be placed in successive layers on the pallet so placed with the beams of the cross-frame being below the top of a previously-deposited layer, and
j. a friction drive for effecting back-and-forth movement of the shuttle table.

17. Pallet loading apparatus as defined in claim 16 wherein there is a support resiliently suspended from the cross-frame at a location beneath the forward end of the shuttle table when it is in retracted position and under the rear portion of the shuttle table when it is in its extended position, at least one friction wheel mounted on said support with its periphery resiliently urged against the under surface of the supporting table, and a reversible motor for driving the friction wheel to provide the friction drive for effecting the back-and-forth movement of the table.

18. Pallet loading apparatus as defined in claim 16 wherein said pallet support comprises a roller table which in turn comprises parallel roller conveyor sections and a supporting frame to which said sections are affixed, said supporting frame being removably set in the base and of such dimension that the conveyors may be selectively set crosswise or lengthwise with respect to the longitudinal axis of the vertically-movable cross-frame.

19. Pallet loading apparatus as defined in claim 16 in which said friction drive is a motor-driven friction wheel on the cross-frame resiliently bearing against the underside of the shuttle table, the shuttle table being free to lift vertically should the shuttle table strike the top of a load by accidental lowering of the cross-frame when the shuttle table is over the open forward end of the cross-frame and it strikes the load in position on the pallet.

20. Pallet loading apparatus as defined in claim 17 wherein there are switch means on the forward end of the shuttle car to stop its driving means if the shuttle table moves forward against the load being placed on a pallet and also for stopping the means for lowering the cross-frame if the cross-frame lowers to bring the shuttle table into contact with a load already in position on the pallet.

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