July 18, 1961 T. A. SPILLIOS 2,992,749

METHOD OF HANDLING STRIP OR BAR MATERIALS

Original Filed July 9, 1953 7 Sheets-Sheet 1

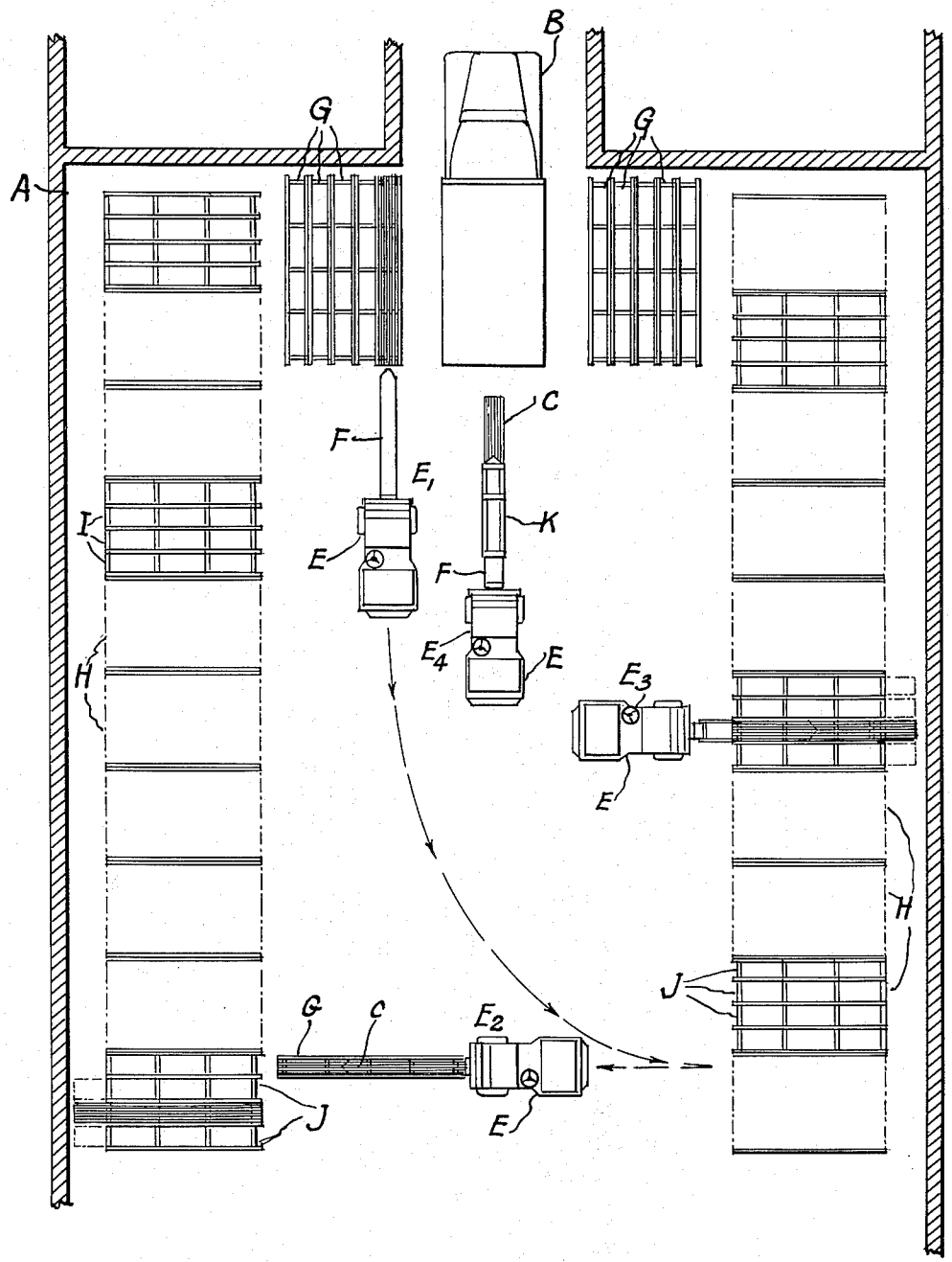

Fig. 1

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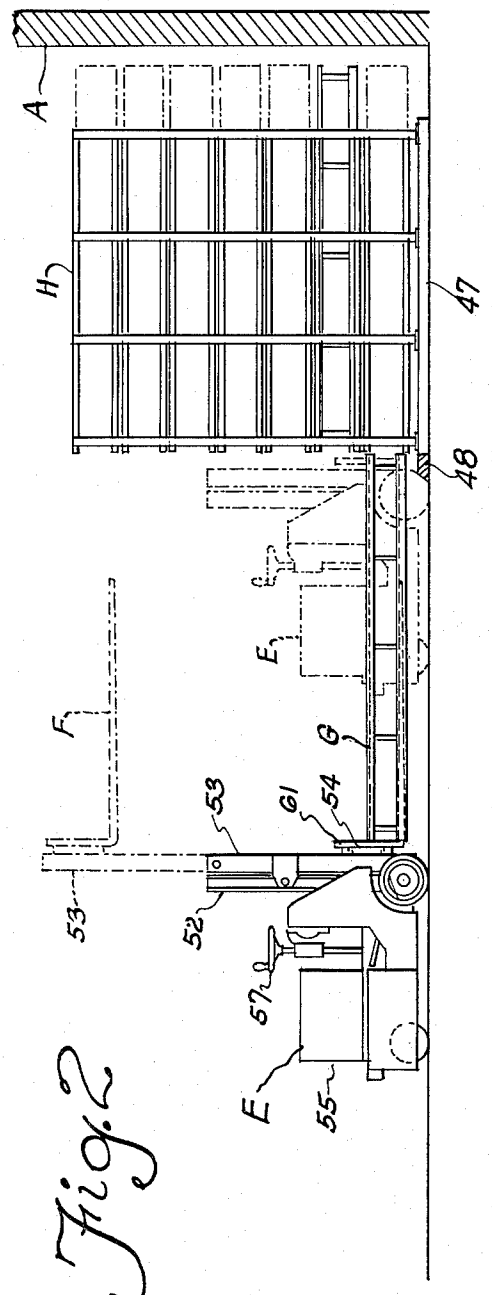

Fig. 2

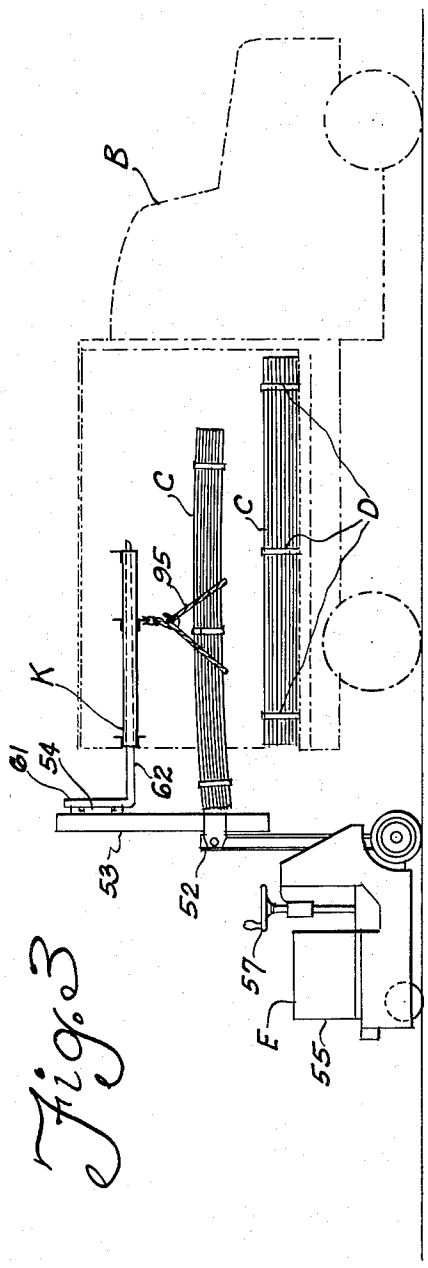

Fig. 3

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Fig. 4

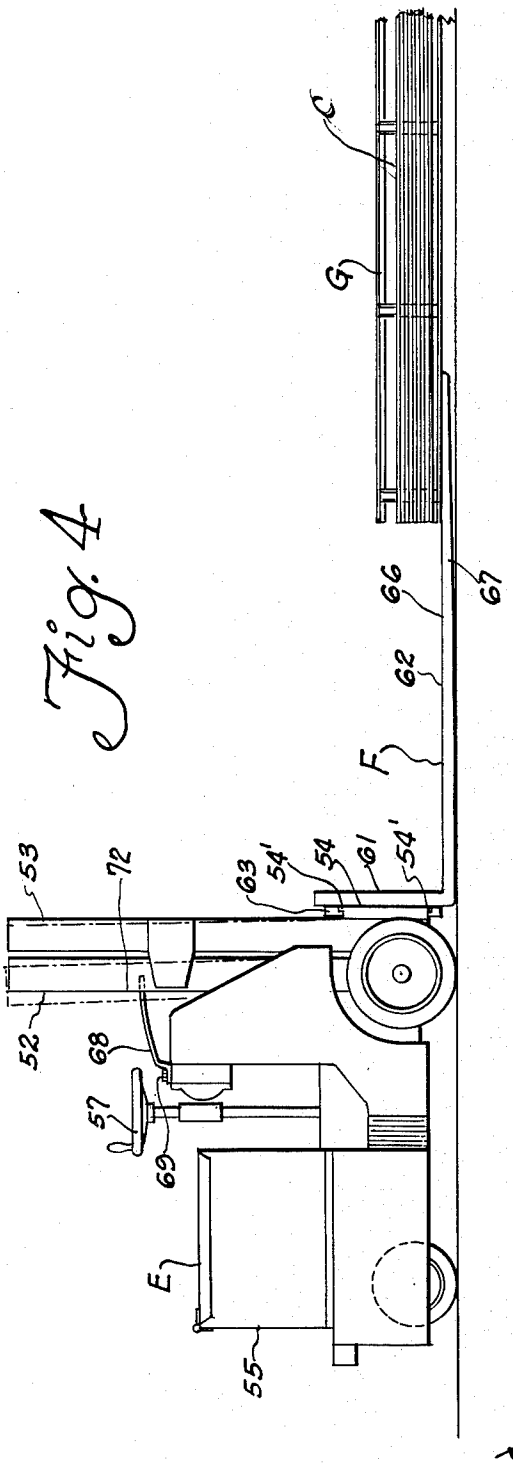

Fig. 5

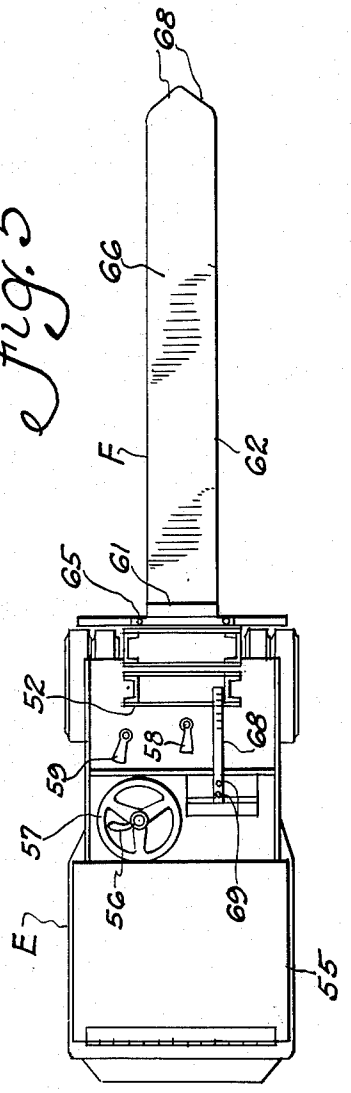

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Fig. 6

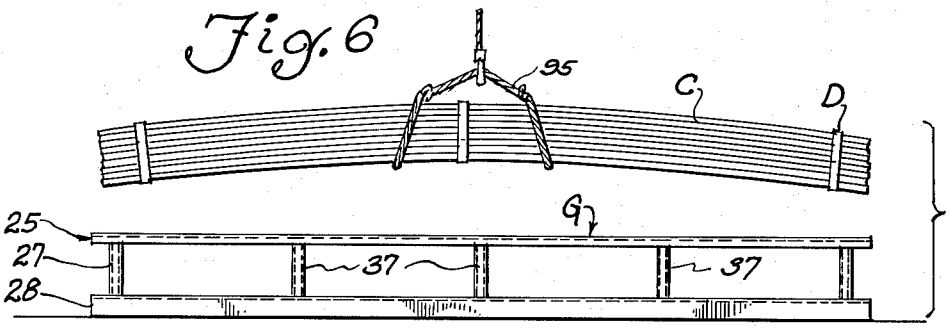


Fig. 7

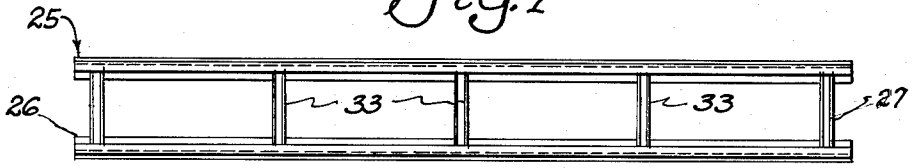


Fig. 8

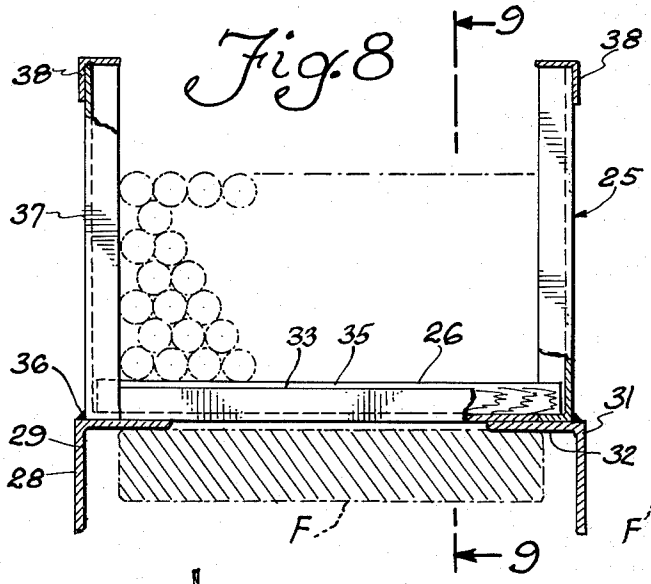


Fig. 9

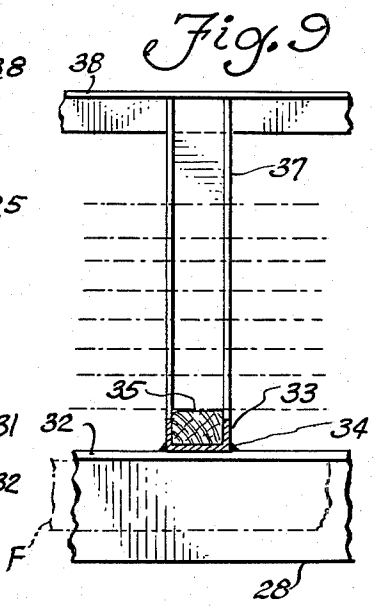


Fig. 10

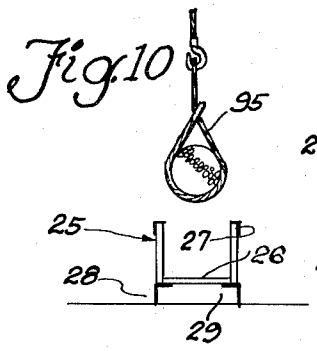
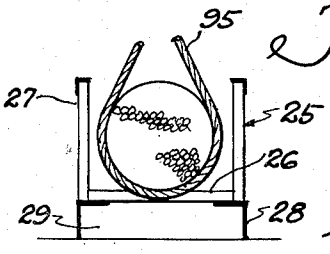


Fig. 11



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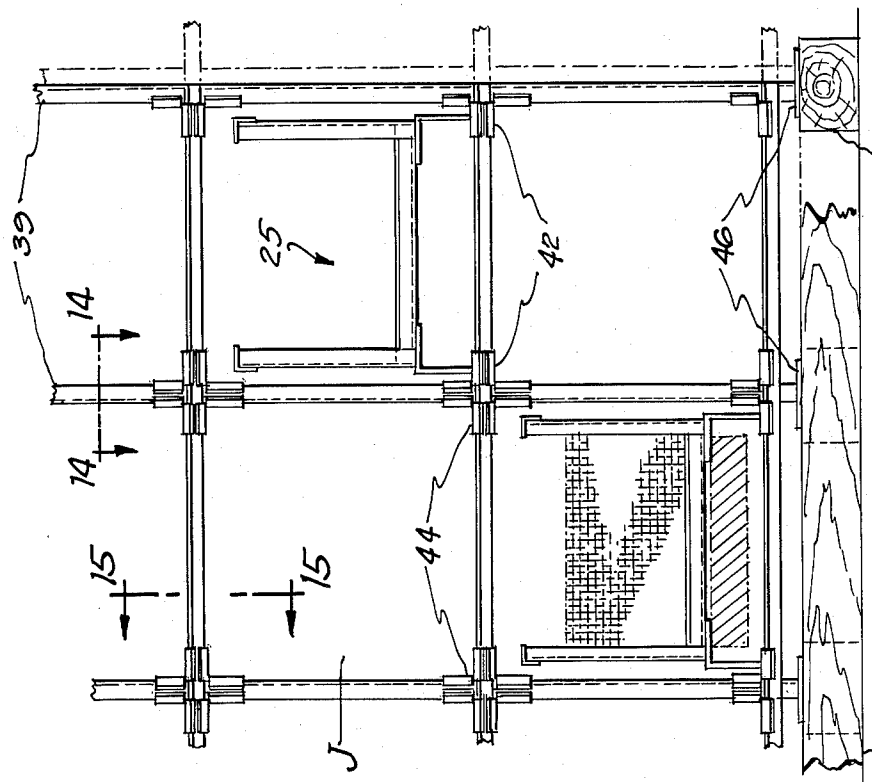

Fig. 13

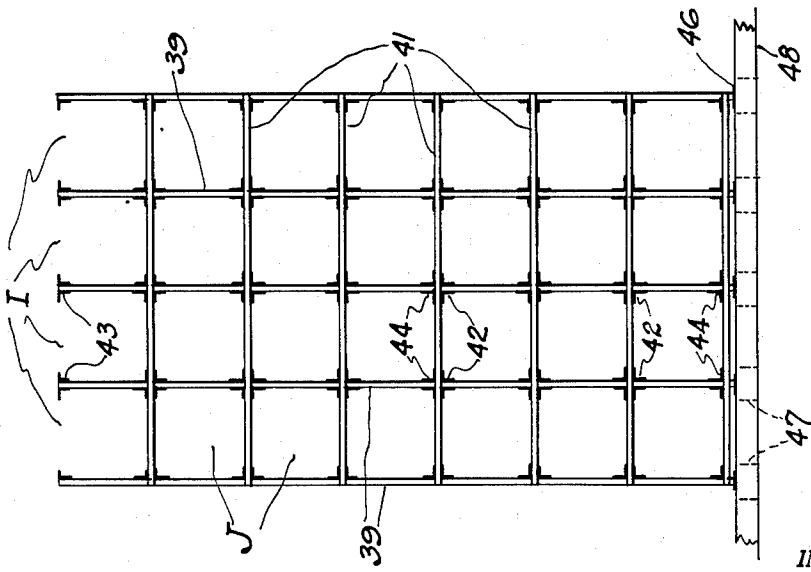

Fig. 12

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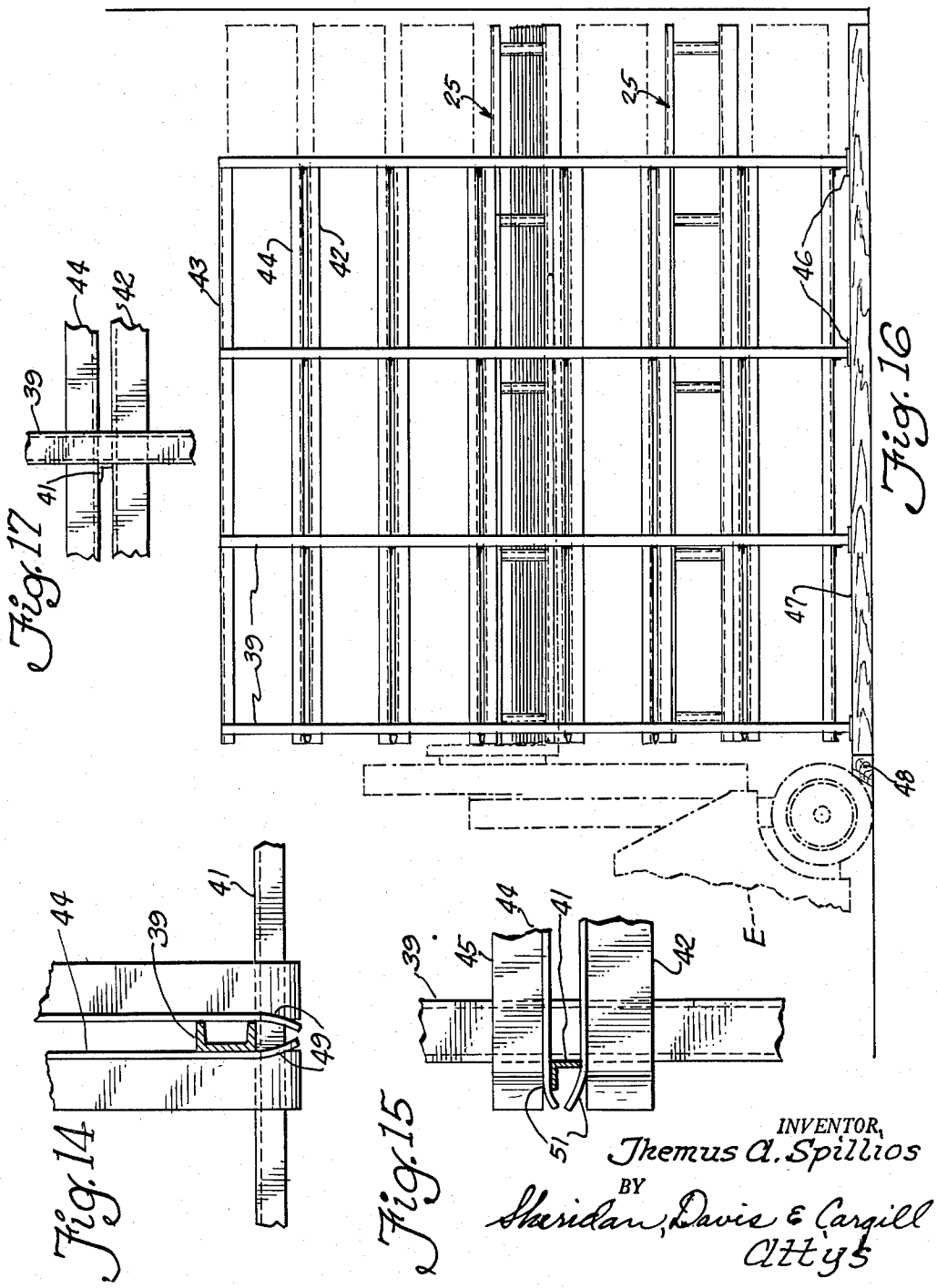

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METHOD OF HANDLING STRIP OR BAR MATERIALS

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Fig. 18

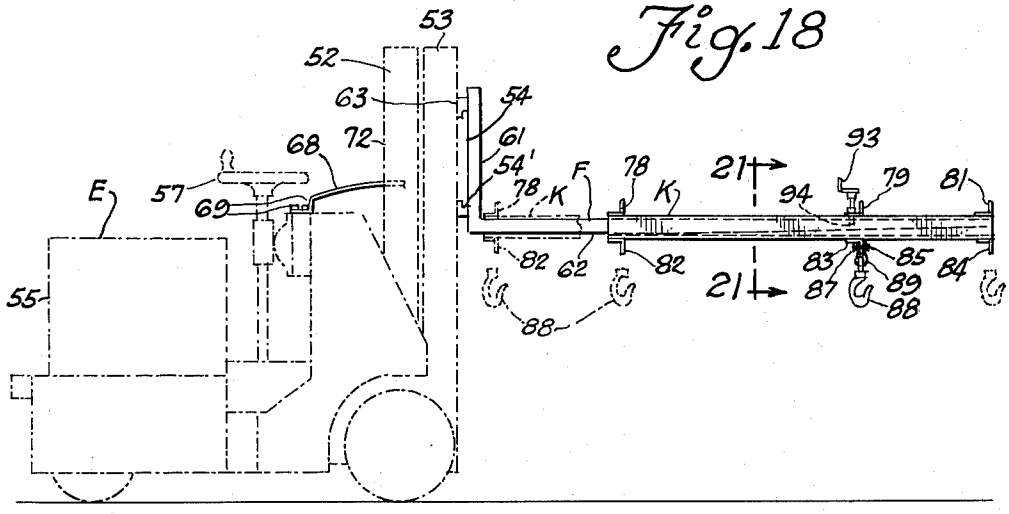
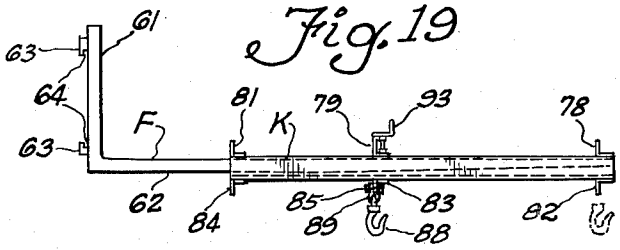


Fig. 19



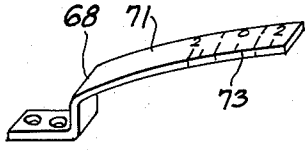


Fig. 22

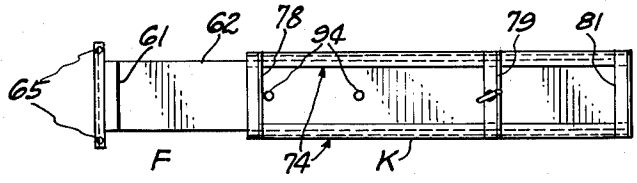


Fig. 20

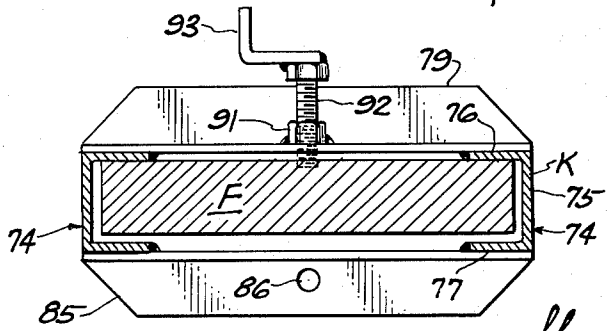


Fig. 21

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United States Patent Office 2,992,749 Patented July 18, 1961

2,992,749

METHOD OF HANDLING STRIP OR BAR MATERIALS

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Continuation of abandoned application Ser. No. 367,057, July 9, 1953. This application Oct. 17, 1960, Ser. No. 64,238

2 Claims. (Cl. 214—152)

This invention relates in general to the warehousing or storage of strip or bar materials of various cross-sectional shapes and sizes and has more particular reference to a method of handling such materials.

The present application is a continuation of my co-pending application Serial No. 367,057, filed July 9, 1953 and now abandoned.

An object of the invention is the provision of a novel and improved method for handling strip or bar material upon its delivery to a warehouse or other place of storage.

Another object of the invention is the provision of such a method whereby bundles of strips upon delivery to the warehouse are so unloaded from the delivery truck or other vehicle, transported to their respective storage positions, and stored as to minimize deformation and defacement of the strips during such handling and storage thereof.

A further object of the invention is the provision of such a method whereby labor, time, and space are saved in handling and storing such strip or bar materials.

Other objects of the invention will appear from the following description which with the accompanying drawing discloses a preferred embodiment of the invention.

In the accompanying drawing wherein the same reference characters designate like parts, respectively, throughout the several views:

FIGURE 1 is a fragmentary cross-section of a warehouse or other building showing more or less diagrammatically a floor plan of handling and storage means embodying some of the features of the invention;

FIG. 2 is a partial cross-section of a warehouse showing a side elevation of a novel storage rack and illustrating the step of inserting therein or withdrawing therefrom a bundle of the strips or bars in accordance with the invention;

FIG. 3 is a side elevation of an automotive lift truck provided with a novel tongue-type lift and shows a removable and adjustable adapter on the tongue-type lift for unloading bundles of the strip from a delivery truck, shown in broken lines, and illustrates the step of unloading the strips according to my novel method;

FIG. 4 is a side elevation of the automotive lift truck shown in FIG. 3 and shows the novel tongue-type lift as it is being moved under or withdrawn from a novel crate or basket (only partially shown) for picking up the crate with or without strips therein, transporting the crate to a desired location, and depositing it in that location;

FIG. 5 is a plan view of the truck shown in FIG. 4;

FIG. 6 is a side view of one of the novel crates partially shown in FIG. 4 and illustrates the step of depositing a bundle of the strips therein;

FIG. 7 is a plan view of the crate shown in FIG. 6;

FIG. 8 is a view in cross-section of one of the novel crates at a different scale from that of FIG. 7 and showing strips of round material therein and the novel tongue-type lift in broken lines engaging the crate;

FIG. 9 is a fragmentary view in cross-section of the novel crate taken substantially along the lines **9—9** of FIG. 8;

FIG. 10 is an end view of the apparatus shown in FIG. 6;

FIG. 11 is a view similar to FIG. 10 at a larger scale and shows the bundle of strips in the novel crate just before the sling is removed from the bundle;

FIG. 12 is a front view of one of the novel multi-compartment racks adapted to receive and support for storage a plurality of the novel crates of strips;

FIG. 13 is a fragmentary front view of the novel multi-compartment rack at a larger scale than that of FIG. 12 and shows one of the novel crates in each of two of its compartments;

FIG. 14 is a fragmentary cross-section taken substantially along the lines **14—14** of FIG. 13;

FIG. 15 is a fragmentary cross-section taken substantially along the lines **15—15** of FIG. 13;

FIG. 16 is a side view of the multi-compartment rack shown in FIG. 12;

FIG. 17 is a fragmentary detail of the rack shown in FIG. 16 and drawn at a larger scale to bring out a structural feature of the rack;

FIG. 18 is a side view of the tongue-type lift on the automotive lift truck (shown in broken lines) with the adapter shown in full lines in an adjusted position, and in broken lines in a different position;

FIG. 19 is a side view of the tongue-type lift with the adapter shown in a third adjusted position;

FIG. 20 is a plan view of the tongue-type lift with the adapter shown in the adjusted position illustrated in full lines in FIG. 18;

FIG. 21 is a cross-sectional view taken substantially along the lines **21—21** of FIG. 18; and

FIG. 22 is a perspective view of the scale portion of a level indicator for the tongue-type lift.

Strips or bars of various cross-sectional shapes and sizes, made of, for example, metal, are tied together in bundles for shipment to warehouses. The bundles of metal strips are 10, 12, 16 and 22 feet in length. A 12-foot bundle of such strips of, for example, steel, weighs about 3,000 pounds.

Upon arrival of a delivery truck loaded with such bundles at a warehouse, it has hitherto been customary to wind a removale sling, usually of metal cable, about a mid portion of one of the bundles, engage that sling in a hook of a turret- or rotary-type jib crane or of an overhead track-type, travelling crane, operate the crane to remove the bundle from the truck, remove the sling from that bundle, place it on another bundle in the truck, re-engage the crane hook with the sling, again operate the crane to remove that other bundle from the truck, and so on until all of the bundles are removed from the truck. Frequently, however, the delivery truck is of the van type, thus necessitating considerable manual effort or jockeying of the delivery truck to remove each bundle therefrom by means of either of those types of cranes.

In thus being removed from the delivery truck, according to a known method, the bundles are sometimes first placed on spaced, parallel timbers or other suitable supports and thereafter by the crane and sling removed one at a time to and moved end-on into individual compartments of a multi-compartment bin. At other times each bundle is removed directly from the delivery truck to and moved end-on into a compartment of such a bin. In another known method, the bundles are removed from the delivery truck as described above, and each bundle is placed in a crate. The loaded crates are thereafter picked up by the crane and stacked on top of one another in vertical columns.

Where multi-compartment bins are employed for receiving the bundles, neither of those types of crane is adapted to support the bundle during the entire time required to place the full length thereof in the bin compartment. Consequently, besides the manual effort required axially to align each bundle with and partially

move it into its compartment while supported by the crane, considerable additional manual effort is required to slide the heavy bundle in the bin compartment until it is all the way in. Likewise in removing each bundle from its bin compartment, manual effort is required to slide the bundle outwardly until it may be picked up by the crane.

Under the load of its own weight, the bundle sags about the sling support, and where it is frequently so picked up or where it is so supported for considerable periods of time, the deformity of some of the strips in the bundle becomes permanent. In sliding the bundles into and out of their respective bin compartments, the peripheral surfaces and ends of some of the strips are frequently marred. The deformation and defacement of the strips render them unsuitable for some uses.

Whether stacked crates or such bins are employed, the effective height of storage space is limited to the combined heights of about four (4) crates or bin compartments, because of the necessity of the manual effort required to guide the suspended bundle and to move it laterally of the direction of travel of the crane hook. Obviously both of those types of cranes can be effective over only limited areas in handling such bundles. Consequently a plurality of cranes is necessary even in relatively small warehouses, and even where provided they do not permit the use of more than a relatively small fraction of the available storage space because of the height limitation. The stacked crates, moreover, are objectionable in that they may require handling of a plurality of the loaded crates above and in the same stack with a lower crate in order to remove the lower crate loaded with strips of the size and shape desired by a customer.

The novel method of the present invention for overcoming the foregoing disadvantages comprises: placing each bundle, as it is removed from the delivery truck, in a crate adapted to receive one of the bundles and support it on a bundle supporting portion spaced above the floor or other support means; arranging a tongue-type lift more than half, preferably about two-thirds the length of the crate in axial alignment with the loaded crate and at a level just below the bundle supporting portion thereof; moving while guiding the tongue-type lift end-on longitudinally of the crate until the entire length of the tongue-type lift is under the bundle supporting portion of the crate; elevating the tongue-type lift to elevate the loaded crate above the support means; while thus supporting the loaded crate throughout more than half of its length on the tongue-type lift, moving the loaded lift to the receiving end of a multi-compartment rack with adjacent vertical rows of compartments, each adapted to receive one of the crates and support it throughout more than half of its length; adjusting the loaded lift to move it into substantially coaxial alignment with any desired one of the rack compartments at the receiving end thereof; moving while guiding the loaded lift end-on into that rack compartment; reversing the movement of the tongue-type lift while in that rack compartment without correspondingly moving the loaded crate therein to withdraw the lift from the rack compartment and to leave the loaded crate therein; and repeating the foregoing steps for each bundle of strips.

Referring now to the accompanying drawing, FIG. 1 shows, more or less diagrammatically a portion of the storage room A of a warehouse with a van-type delivery truck B in an unloading position. The truck B contains, for example, twelve-foot bundles C of say round steel strips suitably tied together by metal straps D. Such bundles are shown best in FIGS. 2, 6, and 11.

As illustrated in FIG. 1, an automotive lift truck E, preferably of the electromotive type, is provided with a novel tongue-type lift F. That lift truck E at position E_1 is movable forwardly to move the lift F under one of a plurality of crates G, which contains one of the bundles C, whereby the loaded crate may be picked up and transported on the lift F of the truck E to a storage position. For receiving the loaded crates G, a plurality of multi-compartment storage racks H, each having a plurality of adjacent vertical rows I of horizontally extending compartments J, are arranged, for example, along the side walls of the warehouse storage room. The truck E is shown at positions E_2 and E_3 in the process of inserting or withdrawing loaded crates G into or from rack compartments J.

The tongue-type lift F of the lift truck E or a similar truck, as shown in position E_4 of FIG. 1, is adapted to carry an adapter K removably and adjustably mounted on the lift F. The lift truck E is movable to move the lift F and the adapter K into and out of the body of the delivery truck whereby a bundle C may be removed from the delivery truck and placed in one of the crates G.

The crates G are identical with one another. Only one of them therefore needs to be described. The structural details of one of the crates are shown best in FIGS. 6 to 11. As therein illustrated, each crate G comprises an elongated box-like structure **25** open at its top and ends and having a bundle supporting bottom portion **26** and upright, longitudinal side portions **27** extending upwardly from and along the longitudinal margins of the bottom portion **26**. That box-like structure is of sufficient length and cross-sectional area to receive through its open top one of the bundles C, and is mounted on spaced supporting members **28** depending from the longitudinal margins of the bottom portion **26**. By so mounting the box-like structure on the members **28**, a space **29**, open at its ends and bottom and coextensive in length with the box-like structure, is provided beneath the bottom portion **26** between the members **28** to facilitate handling and storing the crate.

Illustrative of the construction of such a crate, it is presently preferred to provide a pair of spaced parallel metal angle members **31** having spaced horizontal flanges **32** extending inwardly toward each other from the upper ends of depending flanges which are adapted to serve as the spaced supporting members **28**. The angle members **31** are substantially equal in length to the bundles C. Near each of the opposite ends of the pair of angle members **31** at positions spaced apart a distance less than the length of a bundle C, and at each of a plurality of equi-spaced intermediate positions, a metal channel member **33** bridges the space between the angle members **31** and has its opposite ends on and welded, as at **34** (FIG. 9), to the horizontal flanges **32**.

Five of such channel members **33** have been found and are shown in FIG. 7 to be sufficient for twelve-foot bundles of steel strips. Each channel member **33** carries a strip of wood **35** equal in length to the channel member, inserted through the open top thereof into the space between its parallel flanges, and extending above their upper edges. The channel members **33** and strips of wood **35** provide the bundle supporting bottom portion **26** of the box-like structure **25**. They are sufficient in number and so spaced that the strips of a bundle C, while in the crate G, are so supported on the bottom portion **26** as to resist bending or similar deformation due to gravity. The wood strips **35** are adapted to protect the strips of a bundle C from abrasion and other surface defacement during insertion and removal of the strips in and from the crate and during storage of the strips therein.

Supported on and welded, as at **36** (FIG. 8), to the horizontal flanges **32** at the opposite ends of each channel member **33** are identical upright channel members **37** with their parallel flanges extending inwardly from their connecting flanges, respectively, and transversely of the bottom portion **26** of the box-like structure **25**. The upper ends of the upright channel members **37** along each longitudinal side of the bottom portion **26** are

welded or otherwise suitably secured to a metal angle member 38, which is preferably co-extensive in length with the angle members 31. When so constructed and arranged the upright channel members 37 and angle members 38 provide the longitudinal side portions 27 of the box-like structure 25.

The storage racks H are identical with one another. Only one of them therefore needs to be described. The structural details of one of them are shown best in FIGS. 12 to 17. As therein illustrated, each rack H comprises four of the adjacent vertical rows I of the compartments J, there being seven of the compartments J in each vertical row. The compartments J extend horizontally from the front or receiving end to the rear end of the rack and the corresponding compartments in the vertical rows are at the same level transversely of the rack. Each compartment J has a length not less than half, preferably about three-fourths, that of the crate G and somewhat greater vertical and transverse dimensions than those of the crate G, whereby the crate is receivable in any of the compartments from the open receiving or front end of the rack.

The presently preferred construction of such a rack H comprises five equi-spaced rows of vertical, metal channel members 39, with four channel members in each row equi-spaced from one another from front to rear of the rack. Those channel members 39 are secured together in that relationship by four equi-spaced vertical rows of horizontal, equally vertically spaced metal angle members 41, with seven angle members in each vertical row thereof. Those angle members 41 are arranged transversely of the rows of the channel members 39, with the uppermost angle member in each row thereof spaced below the upper ends of the channel members a distance equal to the spacing between vertically successive angle members, and are respectively welded or otherwise suitably fastened to the respectively corresponding channel members in the rows thereof.

In the upper inside corners of each of the compartments J, except the top horizontal row of compartments, and extending from the front to the rear end thereof, are metal angle members 42 with their horizontal flanges engaging under the angle members 41 and with their depending vertical flanges welded or otherwise suitably secured to the adjacent channel members 39. Similar angle members 43 are likewise secured along the opposite upper, longitudinal sides of the top compartment J of each vertical row thereof. In the lower inside corners of each compartment J and extending the full length thereof are metal angle members 44 with their horizontal flanges 45 engaging on the angle members 41 and with their upwardly extending vertical flanges welded or otherwise suitably secured to the adjacent channel members 39. The horizontal flanges 45 of the angle members 44 of each compartment J are adapted to serve as supporting runways for the supporting members 28 of the crates G, and the vertical flanges of the angle members 42 or 43, and 44 are adapted to serve as guide members for the crats G during insertion and withdrawal thereof in and from the compartment.

The channel members 39 extend below the lowermost angle members 41. The lower ends of those channel members in each row thereof are provided with metal plates or feet 46 suitably secured on wooden timbers 47 anchored to the floor of the storage room. Abutting the front ends of those timbers 47 and extending across the front or receiving end of each rack H is a timber 48 engageable as shown in FIG. 16 by the front wheels of the lift truck E to limit its forward movement during the step of inserting a bundle C in any of the compartments J. As shown best in FIGS. 14 and 15, the angle members 42, 43, and 44 extend forwardly beyond the front channel members 39 and angle members 41 and are slit along their vertices. At the forward ends of those angle members 42, 43, and 44, the vertical flanges are bent or otherwise flared as at 49 (FIG. 14) outwardly at opposite sides of each compartment J and the horizontal flanges are bent or otherwise flared as at 51 (FIG. 15) downwardly at the bottom and upwardly at the top of each compartment to facilitate the insertion of the crates G into the compartments J.

Where the storage racks H are shorter than the crates G as described above, the racks, as shown in FIG. 1, are spaced at their rear ends from the walls of the storage room sufficiently to permit the crates to be inserted in the rack compartments without projecting beyond the forward ends thereof.

The lift truck or trucks E per se form no part of the present invention. As an aid to a better understanding of the invention, however, it may be well briefly to point out that such a lift truck is, as illustrated in FIGS. 2 to 5 and 18, provided at its front end with an upright hoist support 52 which extends upwardly from and is adjustable about the axis of the truck's front wheels. That hoist support carries a hoist structure 53 which is about equal in length to the hoist support, is parallel thereto, and is vertically reciprocable therealong. The hoist structure 53 has mounted thereon an upright lift supporting means or plate 54 which has a pair of external flanges 54' along its upper and lower ends and which is reciprocable along the hoist structure.

The illustrated lift truck is adapted to be energized by electric storage batteries (not shown) in a housing 55 at the rear end of the truck. Such a lift truck comprises transmission control means 56 for controlling forward and rear movement of the lift truck, steering means 57, level control means 58 for controlling the adjustment of the hoist support 52 about the front wheel axis of the truck, and hoist control means 59 for controlling the vertical movements of the hoist structure 53 and lift supporting plate 54.

It will be understood by those skilled in the art that such a lift truck is maneuverable under the control of the transmission control and steering means 56 and 57. Usually the truck is provided with a prong or fork-type lift removably mounted on the lift supporting plate 54 having the prongs thereof extending horizontally forwardly from its lower end. With a spirit or other level on the prongs, they are adjustable to a level position by manipulation of the level control means 58. By manipulating the hoist control means 59, the lift supporting plate 54 is adjustable along the hoist structure 53 from its lowermost position at which the lift prongs engage on the floor or from an upper position at the upper end of the hoist structure to the other of those positions or to any intermediate position. With the lift supporting plate at its upper position, by manipulation of the hoist control means 59, the hoist structure 53 is adjustable along the upright hoist support 52 from its lowermost position at which it is substantially coextensive in length with the hoist support or from its uppermost position at which the lower end of the hoist structure is near the upper end of the hoist support 52 to the other of those positions or to any intermediate position. Thus the lift prongs of such a truck are adjustable from the floor position or from its uppermost position at an elevation substantially twice the length of the hoist support 52 to either of those positions or to any intermediate elevation.

Due to the fact that the prongs of the well-known prong-type lift are only about three feet long and to the relatively great width of such lifts, they are incapable either of handling a load such as one of the bundles C or of inserting such a load in a suitable storage rack. To attain the advantages of speed and maneuverability possible with the lift truck E in handling and storing such loads, according to the objects of the present invention, the lift truck is provided with the novel tongue-type lift F.

Such a tongue-type lift is shown best in FIGS. 2 to 5

and 18 to 21. As therein illustrated it is forged or otherwise formed of steel and is substantially L-shaped having a relatively short mounting arm 61 and a carrier arm 62 integral with an end of the mounting arm and extending substantially at right angles therefrom. The novel tongue-type lift is adapted to be so mounted on and carried by the lift supporting plate 54 that the mounting arm is held in an upright position against the forward face of the lift supporting plate 54, and the carrier arm 62 extends forwardly from the lower end of the mounting arm.

Suitable means for so mounting the tongue-type lift comprises a pair of brackets 63 on the rear face of the mounting arm 61 and integral therewith. They extend transversely of the mounting arm beyond its side edges and are provided with opposed grooves 64 which are vertically spaced sufficiently and are of such dimensions as to cooperate with the flanges 54' along the upper and lower ends of the lift supporting plate 54 to secure the tongue-type lift thereon against vertical movement relative thereto. A pair of bolts or other suitable fastening means 65 attach the upper bracket 63 to the lift supporting plate 54 to prevent horizontal movement of the tongue-type lift relative to the lift supporting plate.

The carrier arm 62 of the tongue-type lift is provided with a length greater than half, preferably about two-thirds that of the crates G and a width slightly less than that of the space 29 between the crate supporting members 28. That carrier arm has a thickness at its end adjacent the mounting arm 61 somewhat less than the depth of the space 29, an upper surface 66 (FIGS. 4 and 5) at right angles to the mounting arm, and a lower surface 67 (FIG. 4) inclining upwardly toward the upper surface 66 from its end adjacent the mounting arm 61 to the opposite end of the carrier arm. At its forward end the carrier arm is provided with converging sides 68. It is thus of tapering thickness and has a tapering outer end to facilitate inserting it in and withdrawing it from the space 29 of the crates G for handling such crates.

To facilitate leveling the carrier arm 62, the lift truck E is provided with level indicating means. Such means is shown best in FIGS. 4, 5, 18, and 22. As illustrated, that means includes a flat strip 68 of metal or other suitable material which is mounted at one end adjacent the level control means 58 on the instrument panel of the lift truck by bolts or other securing means 69. That strip 68 has a substantially horizontal arm 71 which extends forwardly beyond the rear face 72 of the upright hoist support 52 and which near its forward end is adjacent an upright edge of that face 72. The forward end of the arm 71 bears a scale 73 along which the rear face 72 moves as the hoist support 52 is adjusted about its axis by manipulation of the level control means 58.

That scale 73 is made by manipulating the level control means 58 until the carrier arm 62, moving with the hoist support 52 about its axis, is level. At that position of the carrier arm, an indicium line O is marked or otherwise made on the arm 71 transversely thereof and aligned with the rear face 72 of the hoist support 52. The level control is then manipulated to tilt the carrier arm 62 through one or more equal angles first above and then below the level position to determine the positions of indicia lines 1 and 2 at the right and left, respectively, of the indicium line O (FIG. 22) which are marked or otherwise made on the arm 71 in alignment with the rear face 72 at its positions respectively corresponding to those of the carrier arm.

In operation, the level control means 58 is manipulated to align the rear face 72 of the hoist support 52 with the indicium line O on the scale 73 whereby to level the carrier arm 62. With that carrier arm level, the lift truck E is maneuvered under the control of the transmission control and steering means 56 and 57 to a position at which the carrier arm extends forwardly therefrom toward an end of one of the loaded crates G and the longitudinal axes of the carrier arm and that crate are in the same vertical plane. In that position, the hoist control means 59 is manipulated to lower, if the crate is on the floor, or, if it is in one of the rack compartments J, to elevate or, as the case may be, to lower the carrier arm to a position at which it is coaxial with and axially spaced from the space 29 of the crate. When the carrier arm 62 is thus aligned with the space 29 of the desired crate G, the transmission control means 56 is manipulated to cause the lift truck to move forwardly whereby to impart end-one movement to the carrier arm and move it into that space 29 beneath the bundle supporting bottom portion 26 of the crate. The forward movement of the lift truck is continued until the entire carrier arm is in the space 29.

While the carrier arm 62 is in the space 29, the hoist control means 59 is again operated to elevate the carrier arm. During such elevation of the carrier arm, its upper surface engages the bottom portion 26 of the crate. The carrier arm is further elevated to lift the crate clear of the floor or, as the case may be, of the horizontal flanges 45 of the angle members 44 in one of the rack compartments J.

With the crate supported throughout more than half its length on the carrier arm 62 above the floor or the horizontal flanges 45 in one of the rack compartments J, the transmission control means 56 is manipulated to cause the lift truck to move rearwardly whereby to withdraw the carrier arm and the crate supported thereon by end-on movement from the rack compartment or from its position at one side of the delivery truck B. If the crate is thus withdrawn from the rack compartment, it is transported on the carrier arm by maneuvering the lift truck to another desired position in the warehouse, for example, to a weighing scale (not shown) for weighing preparatory to selling some or all of the strips in the crate.

Where the crate is, after it is loaded, withdrawn from its position at one side of the delivery truck B, as just described, for storing in one of the rack compartments J or is to be returned to one of those compartments, the lift truck E is maneuvered under the control of the transmission control and steering means 56 and 57 to a position at which the carrier arm with the crate supported thereon extends forwardly from the lift truck toward the front end of one of the vertical rows I of the rack compartments J including the rack compartment in which the crate is to be stored, and at which the longitudinal axes of the crate G on the carrier arm and that of rack compartment which is to receive it are in the same vertical plane. In that position of the crate to be stored, the hoist control means 59 is manipulated to lower or to elevate, whichever is necessary, the carrier arm and the crate thereon to a position at which the crate is coaxial with and axially spaced from the desired rack compartment J.

When the crate on the carrier arm 62 is thus aligned with the desired rack compartment J, the transmission control means 56 is manipulated to cause the lift truck E to move forwardly whereby to impart end-on movement to the carrier arm and crate thereon and move them into the rack compartment. The forward movement of the lift truck is continued until the trailing end of the crate on the carrier arm is substantially coplanar with the front end of the rack compartment as will be indicated by the front wheels of the lift truck engaging the timber 48. While the carrier arm with the crate thereon is in the rack compartment J, the hoist control means 59 is again manipulated to lower the carrier arm in the space 29 out of engagement with the bottom portion 26 of the crate, whereupon the crate is supported in the rack compartment by engagement of the supporting members 28 on the horizontal flanges 45 of the angle members 44. After the carrier arm 62 is thus disengaged from the bottom portion 26 of the crate, the transmission control means 56 is manipulated to cause the lift truck E to move

rearwardly whereby to withdraw the carrier arm from the space 29 and leave the crate in the rack compartment.

To facilitate unloading the delivery truck B, especially where it is of the van type, the adapter K is so constructed as to be removably mounted on the carrier arm 62 for slidable adjustment longitudinally thereof, and preferably is about three-fourths the length of the carrier arm. The presently preferred adapter is shown best in FIGS. 18 to 21. As therein illustrated, it comprises a pair of spaced, parallel, metal channel members 74 about three-fourths the length of the carrier arm 62 and providing the longitudinal sides of the adapter. Each of those channel members has a vertical flange 75, an upper horizontal flange 76 along the upper margin of the vertical flange, and a lower horizontal flange 77 along the lower margin of the vertical flange. The upper and lower flanges 76 and 77 of each channel member extend inwardly from the vertical flange 75 thereof toward the other channel member, and are in the same planes as those of the other channel member, respectively.

The channel members 74 are of such size that their upper and lower flanges are spaced apart enough slidably to receive therebetween the longitudinal side margins of the carrier arm 62. With the parallel channel members so arranged that their vertical flanges 75 are spaced apart a distance slightly greater than the width of the carrier arm, the channel members are secured in spaced parallelsm by three transverse metal angle members 78, 79, and 81 spaced apart longitudinally of the channel members and having their respective opposite ends welded to or otherwise suitably secured on the upper faces of the horizontal flanges 76, and three transverse metal angle members 82, 83, and 84 similarly spaced longitudinally of the channel members and having their respective opposite ends welded or otherwise suitably secured to the lower faces of the horizontal flanges 77.

The angle members 78 and 82 are at one end and the angle members 81 and 84 are at the opposite end of the adapter K, while the angle members 79 and 83 are intermediate the ends of the adapter and preferably about one-third its length, i.e., about one-fourth the length of the carrier arm from the angle members 81 and 84. Each of the angle members 82, 83, and 84 includes a depending vertical flange 85 extending transversely of the adapter and having centrally thereof an aperture 86 (FIG. 21) for receiving a clevis pin or bolt 87. A hook 88 carried by a substantially U-shaped clevis 89 is attachable to any one of the vertical flanges 85 by the clevis bolt 87 passing through the spaced, parallel, arms of the clevis 89 and the aperture 86 of the flange 85 therebetween.

With the adapter K and the carrier arm 62 in coaxial alignment and axially spaced relationship and with either end of the adapter, for example, that having the angle members 78 and 82, forwardly adjacent the forward end of the carrier arm, one of the adapter or carrier arms is moved axially toward the other until the opposite end of the adapter is flush with the forward end of the carrier arm. When the adapter is so mounted, the upper flanges 76 of its channel members 74 slidingly engage on the upper surface 66 of the carrier arm along the longitudinal margins thereof to support the adapter.

When the adapter K is in that position on the carrier arm (FIGS. 18 and 20), the hook 88 is located one-fourth the length, three-fourths the length, or the full length of the carrier arm 62 from the mounting arm 61 of the tongue-type lift F, when the hook is attached to the angle member 82, 83, or 84, respectively. By sliding the adapter along the carrier arm until its end having the angle members 78 and 82 engages the mounting arm 61 (broken lines, FIG. 18), the hook is located at the inner end of the carrier arm or at one-half or three-fourths the length of the carrier arm from the mounting arm 61 when the hook is attached to the angle member 82, 83, or 84, respectively.

If the adapter is mounted on the carrier arm with the end of the adapter having the angle members 78 and 82 flush with the forward end of the carrier arm, which may be done initially or by removing the adapter mounted as first described above, reversing it end-for-end, and remounting it on the carrier arm, the hook 88 is located one-fourth the length, one-half the length, or the full length of the carrier arm from the mounting arm 61 when the hook is attached to the angle member 84, 83, or 82, respectively. By sliding the adapter along the carrier arm until its end having the angle members 81 and 84 engages the mounting arm 61, the hook is located at the inner end of the carrier arm or at one-fourth or three-fourths the length of the carrier arm from the mounting arm 61 when the hook is attached to the angle member 84, 83, or 82, respectively.

If desired, the angle member 79 is provided with an apertured boss 91 which is internally threaded to receive an externally threaded bolt 92 having a crank or other suitable handle 93 at an end thereof. The bolt 92 is adapted to cooperate with depressions or recesses 94 provided in the upper surface 66 of the carrier arm to serve as means for releasably locking the adapter K in its various positions of adjustment relative to the carrier arm. Thus the adapter K cooperates with the lift truck E and the tongue-type lift F to provide a mobile crane with a boom the effective length of which is adjustable.

Such a crane is particularly advantageous in unloading the bundles C from the delivery truck B, and transporting them to and placing them in the crates G preparatory to storing the loaded crates in the storage racks as already described. To perform those steps, the adapter is mounted on the carrier arm and adjusted relative thereto to locate the hook 88 in the desired position, for example, that position which is three-fourths the length of the carrier arm 62 from the mounting arm 61. With the adapter releasably locked in that position on the carrier arm, the lift truck E is maneuvered into such a position at the rear end of the delivery truck B that the carrier arm carrying the adapter extends forwardly from the lift truck to adjacent the rear end of the delivery truck. By manipulating the hoist control means 59 while the lift truck is in that position, the carrier arm, adapter, and hook are elevated to a level between the upper level of the bundles C in the delivery truck and the top of the van thereof. The transmission control means 56 is now manipulated to cause the lift truck E to move forwardly whereby to move the carrier arm forwardly into the van of the delivery truck.

A more or less conventional sling 95 (FIGS. 3, 6, 10, and 11) preferably of metal cable is wound about the midportion of one of the bundles C in the van of the delivery truck and engaged with the hook 88 depending from the adapter K on the carrier arm 62 while it is in the van of the delivery truck as just described. When the sling 95 about the bundle C has thus been engaged with the hook 88, the hoist control means 59 is manipulated to elevate the carrier arm 62, adapter K, and hook 88 whereby to pick-up the bundle C in the delivery truck. While supporting that bundle C suspended from the hook 88 by the sling 95, the lift truck is caused to move rearwardly (FIG. 3) by manipulation of the transmission control means 56 to withdraw the bundle C from the delivery truck (FIG. 1).

After the bundle C is thus withdrawn from the van of the delivery truck B, the lift truck carrying the bundle is maneuvered to a position at one end of one of the empty crates G at one side of the delivery truck, with the bundle suspended from the adapter on the carrier arm above and in parallel relationship with that crate G. With the bundle in that position (FIGS. 6 and 10), the hoist control means 59 is manipulated to lower the carrier arm, adapter, and hook whereby to deposit the bundle in the crate G (FIG. 11) whereupon the sling 95 is disengaged from the hook 88 and the bundle, and the foregoing steps are repeated for each bundle to be removed from the delivery truck.

As hereinabove disclosed, the bundles of strips are supported while in the crates on a plurality of the wooden strips **35** in transverse members to avoid surface injury to the strips in the bundles due to the weight thereof. Those transverse members are so close together that the support provided thereby minimizes, if not entirely prevents, bending or other deformation of the strips in the bundles due to the weight thereof. In a sense, therefore, the bundles may be said to be supported substantially throughout their lengths in the crates. Except during the relatively short period required to remove a bundle from the delivery truck and deposit it in one of the crates, each bundle is in one of the crates throughout its handling and storage, and therefore the strips in the bundles are not permanently bent or similarly deformed by reason of improper support during the handling and storage of the bundle.

Since the strips in the crates do not bend under their own weight, their ends do not sag as occurs when they are supported only at a mid-portion by, for example, a sling. By avoiding sagging ends during the handling of the bundles, the insertion thereof in the horizontal compartments of the storage racks is facilitated. In addition, the ends of the strips, since they do not sag, cannot scrape and scratch or otherwise deface the surfaces of strips in a lower compartment as a bundle is being inserted in an upper compartment. There being no sagging strip ends, strip bending and end injury to the strips due to the ends of the strips being moved against portions of the storage rack or other fixed object are avoided during the handling and storage of the bundles.

By providing such crates, each with the space **29**, and the tongue-type lift F on the lift truck E, I not only achieve greater mobility, a saving in time and manual labor, more efficient and effective utilization of available storage area, and the ability effectively to utilize a greater storage area without additional handling equipment, as compared with known methods and apparatus for handling and storing such bundles of strips, but I also obtain the advantage of being able to utilize the storage area to a greater height, the available height according to the present invention being limited only by the ceiling height of the storage room and the range of the vertical adjustment provided for the lift supporting means **54** included in the hoist mechanism of the lift truck.

The lift truck E having the tongue-type lift F cooperates with each crate having the space **29** to provide means, while supporting a bundle substantially throughout its length, for picking up the crate with the bundles therein, carrying the thus loaded crate to a desired location, and depositing it in that location on the floor or at a desired elevation above the floor. Stated somewhat differently, the lift truck, the tongue-type lift thereof, the crate, and the space **29** thereof constitute means for picking up the bundle and transporting it to and inserting it in a desired position on or above the floor, while supporting the bundle substantially throughout its length.

The mobile crane resulting from the adapter K on the tongue-type lift of the lift truck greatly facilitates removing the bundles from the delivery truck, especially where it is of the van type, and placing them in the individual crates. Thus the novel apparatus enables me more efficiently to practice the novel method and to save considerable time and labor in unloading, handling, and storing the bundles.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction, and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. In handling warehouse stock of flexible strips of metal having various cross-sectional size and shape characteristics and sorted and bound according to said characteristics into elongated flexible bundles of from about 10 feet to about 22 feet in length whereby each said bundle comprises such strips of the same said cross-sectional characteristics detectable at an end of said bundle, a method of storing said bundles in more than two adjacent substantially vertical rows with more than four of said bundles arranged in horizontal positions one above another in each of the vertical rows, whereby said bundles are selectively removable, one at a time, from all of said rows without displacement of any stored bundle other than the desired selected bundle, which comprises depositing each said bundle and supporting it substantially throughout its length on an elongated rigid carrier whereby to prevent said bundle from flexing during the handling of said carrier with the bundle thereon, pushing an elongated carrier arm by a steerable, automotive lift truck forwardly in an end-on direction parallel to the longitudinal axis of each said carrier with a said bundle thereon to a location beneath more than half the length of said carrier while cantileverly supporting said carrier arm for up-and-down movement on, and extending longitudinally forwardly from, the front of said truck, applying an elevating force to the supported end of said carrier arm to elevate it and said carrier with said bundle thereon, operating said truck while it is cantileverly supporting the elevated carrier arm and said carrier with said bundle thereon to transport said carrier with said bundle thereon by longitudinal movement thereof to the vicinity of any desired substantially vertical row of elongated compartments of a multi-compartment storage rack having more than two adjacent substantially vertical rows of said compartments with more than four of said compartments arranged one above another in each said row, all of said compartments in said more than two adjacent substantially vertical rows thereof having substantially coplanar open ends and extending substantially horizontally therefrom in the same direction, maneuvering said truck to dispose the cantileverly supported carrier arm and said carrier with said bundle thereon, in substantially parallel relationship to the compartments in said desired row thereof and with the end of said carrier with said bundle thereon opposite the supported end of said carrier arm spaced outwardly from the open ends of the compartments in said desired row thereof, adjusting the elevation of said cantileverly supported carrier arm to align it and said carrier with said bundle thereon substantially axially with any selected compartment in said desired row of compartments, moving said truck forwardly and thereby pushing said cantileverly supported carrier arm and said carrier with said bundle thereon in an end-on direction into said selected compartment through the open end thereof to such a position that the trailing end of said carrier is adjacent said open end, establishing engagement between said carrier with said bundle thereon and said storage rack while said carrier arm and said carrier with said bundle thereon are in said selected compartment to enable said carrier arm to move rearwardly relative to said carrier with said bundle thereon in said selected compartment, and moving said truck rearwardly and thereby pulling said cantileverly supported carrier arm axially rearwardly out of said selected compartment through the open end thereof to withdraw said carrier arm from said selected compartment and to leave said carrier with said bundle thereon in said selected compartment.

2. In handling warehouse stock of flexible strips of metal having various cross-sectional size and shape characteristics and sorted and bound according to said characteristics into elongated flexible bundles of from about 10 feet to about 22 feet in length whereby each said bundle comprises such strips of the same said cross-sectional charactertistics detectible at an end of said bundle, said bundles being supported substantially throughout

their respective lengths by elongated rigid carriers to prevent said bundles from flexing during the handling of said carriers with said bundles thereon; and supported in individual compartments of a multi-compartment storage rack having more than two adjacent substantially vertical rows of compartments with more than four of said compartments arranged one above another in each said row, all of said compartments in said more than two adjacent substantially vertical rows thereof having substantially coplanar open ends and extending substantially horizontally therefrom in the same direction whereby to expose an end of the carrier with said bundle thereon in each said compartment, a method of selectively removing the stored carriers with said bundles thereon, one at a time, from all of said compartments without displacement of any stored carrier with said bundle thereon other than the desired selected carrier with said bundle thereon, which comprises the steps of pushing an elongated carrier arm by a steerable, automotive lift truck forwardly in an end-on direction to a location beneath more than half the length of any desired carrier with said bundle thereon in its compartment while cantileverly supporting said carrier arm for up-and-down movement on, and extending longitudinally forwardly from, the front of said truck, applying an elevating force to the supported end of the cantileverly supported carrier arm to elevate it and said carrier with said bundle thereon in said compartment whereby to facilitate longitudinal movement of said carrier with said bundle thereon relative to said compartment, moving said truck and thereby pulling said cantileverly supported carrier arm and said carrier with said bundle thereon axially rearwardly out of said compartment through the open end thereof, operating said truck to transport said carrier with said bundle thereon while they are supported on said carrier arm by end-on movement thereof and of said carrier with said bundle thereon to a desired location, establishing engagement between said carrier with said bundle thereon and stationary means at said location to enable withdrawal movement of said carrier arm relative to said carrier with said bundle thereon, longitudinally withdrawing said cantileverly supported carrier arm from beneath said carrier with said bundle thereon at said desired location, and repeating the foregoing steps for each desired bundle in said storage rack.

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