Dec. 16, 1952 T. N. MELIN 2,621,822

APRON CONSTRUCTION FOR LIFT TRUCKS

Filed June 6, 1949

Fig. 2.

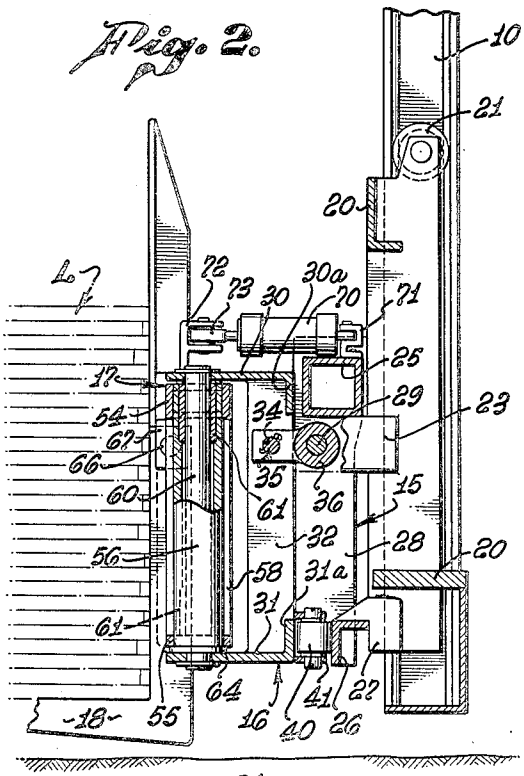


Fig. 1.

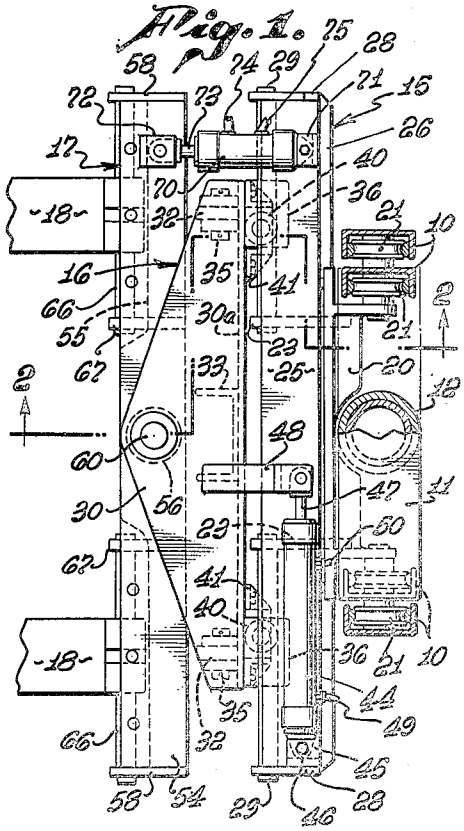


Fig. 4.

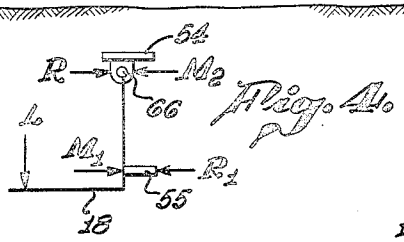


Fig. 3.

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APRON CONSTRUCTION FOR LIFT TRUCKS

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8 Claims. (Cl. 214—730)

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The present invention relates generally to lift trucks of the kind widely used in industrial work for elevating and carrying loads in warehouses, storage yards, and the like; and is more particularly concerned with improvements in the load-carrying apron of fork type trucks.

Industrial lift trucks of the character referred to herein, may be classified according to the type of load-supporting or carrying mechanism with which they are equipped. One of the most widely used types of load-carrying mechanisms is a pair of angularly shaped members with forwardly extending portions which form a platform upon which the load rests. These members are commonly termed "forks"; and consequently a truck so equipped is commonly referred to as a "fork" lift truck. In picking up a load, the forks are first advanced relative to the load and are then raised upwardly to lift and carry the load, this procedure being reversed in order to deposit the load at any desired point. Although the present invention has been designed for particular use in connection with fork lift trucks, and is therefore shown and described in this connection in order to provide a full disclosure, it will be understood that my invention is not necessarily limited thereto in its broader aspects. Some phases of the invention may be applied to other types of lift trucks, as for example the "ram" type, or those with grippers or platform attachments.

The present invention has a particular application in the lumber industry where the size and physical dimensions of the loads create special problems and where the fork type trucks are very widely used. In handling lumber in yards and the like, the loads are generally characterized by their relatively great bulkiness, and particularly by their length, as it is quite common practice to handle loads up to twenty-four feet in length. In stacking loads of lumber, it is essential to obtain vertical alignment between the existing stack and the new load superimposed thereon, or in relation to warehouse walls or fixed bearings or footings on the ground, etc. When loads are the same width, alignment is obtained by vertically aligning the front vertical face of the load with the face of the stack or with some other face or object. Lumber is ordinarily stacked as high as twenty or twenty-two feet, if a truck has sufficient lift. In general, the higher the stack the greater the capacity and economy in use of a yard of given area. However, a stack this high must be steady and well balanced in order to be safe and not present a hazard to life and property; and if proper alignment of superimposed loads cannot be easily and surely obtained in confined areas, then the safe height of the stack is correspondingly reduced. A decrease in the safe stack height results in a correspondingly less efficient use of a given quantity of yard space, or a corresponding increase in the yard space required to stack a given amount of lumber.

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The problem of properly stacking one load on top of another is particularly accentuated when handling lumber, both because of the unusually great length of the load and because of the premium on building a stack as high as possible.

Accuracy of vertical alignment is essential to obtaining a stable stack. For example, if a load of twenty-four foot timbers is twisted about a vertical axis for only one degree with respect to a pile of timbers upon which the load is to be set, the ends of the load are displaced approximately two and one-half inches horizontally from the forward face of the pile, even though perfect alignment is obtained at the center.

If the forks are immovable with respect to the truck frame, the truck as a whole must be shifted in order to change the position of the load, even though it is desired only to rotate the load but slightly on a horizontal plane. Even with an experienced operator this may require considerable backing and turning of the truck, all of which takes time, physical labor, increases tire wear, and ties up expensive equipment so that the overall cost of handling and stacking the lumber is correspondingly increased. Even experienced operators of lift trucks find it extremely difficult to judge proper vertical alignment of the load before depositing it, because their position on the truck is such that they do not have a proper view or perspective to judge alignment until the load is nearly in position to be stacked. These problems are accentuated when it is ordinarily not possible for an operator to make a straight run at an existing stack to add to it, but he must move along an aisle between stacks of lumber and make a sharp turn in cramped quarters. These factors place a great premium on experience in operating a lift truck. But even experienced operators may waste a considerable amount of time in stacking loads.

These considerations have led me to develop a fork lift truck in which the forks or other load engaging means are pivotally mounted in order that the load may be rotated about a vertical axis to a limited extent. These improvements are disclosed in detail in my co-pending application on "Apron Construction for Fork-

Lift Trucks" filed November 1, 1948, Ser. No. 57,737.

However, I find that in constructing a satisfactory apron for pivotal mounting on a truck, various problems in structure arise because of the pivotal mounting. If the base or frame carrying the forks is constructed in a conventional manner, it is not sufficiently strong to resist eccentric loading. It is sufficiently strong to carry balanced loads that are equally, or substantially so, disposed upon the two forks; but when one fork carries a considerably larger load than the other, the eccentric loading causes the frame to twist and rack. This situation cannot be corrected by supporting the frame externally as the outer ends of the frame must be free to move toward and away from the offset to permit pivotal motion of the forks. Hence the apron frame must be so designed as to provide internal resistance to eccentric loading.

The obvious solution to such a problem is to build the frame with a deeper section horizontally in order to strengthen it so that it has greater resistance in beam action and resists bending as a result of loads applied at one end of the frame. This has been found to be impractical for several reasons. In the first place, if the frame is made relatively deep in a horizontal direction, the forks are shifted forward with relation to the main body of the truck so that the center of gravity of the load is further removed from the center of gravity of the unloaded truck. The result is that the loaded truck is unbalanced, and that a smaller load can be handled safely for a given size truck. This can result in a very substantial reduction in the truck capacity; and the reduction may be sufficient to entirely offset other savings. Other ill effects of this unbalanced condition are decreased maneuverability of the truck when making turns or swinging the load because of the increased moment of inertia of the load as it swings in a horizontal arc, and especially because of decreased steering traction of the rear wheels of a loaded truck since the greater lever arm through which the load acts tends to lift the rear wheels off the ground.

Another primary difficulty encountered by making the apron frame of a deep section is that the added plate or bracing members so reduce or restrict visibility of the load that the operator is unable to see the forks through the apron frame. Since the forks are not visible at all times, his operation of the truck is necessarily by feel alone, unless someone outside the truck guides him in its operation, and his efficiency is greatly reduced.

It has been found by experience that a certain amount of offset of the forks ahead of the elevator on the main body is desirable, for example to permit centering the load on the bed of the conventional automotive truck; but this offset should be limited to approximately one foot in order to obtain best operation. This amount of forward shifting of the loaded forks can very conveniently be obtained by an offset frame to which the apron frame is pivotally mounted; and an offset of this distance provides a reasonable and practical amount of angular movement of the apron with respect to the offset frame. If the apron frame is made deeper, measured horizontally, for the reasons mentioned, then the pivotal movement of the apron must be reduced correspondingly or else the amount of offset must be increased, either condition being obviously undesirable.

In addition to the swinging movement obtainable by pivotally mounting the forks, I have found as a matter of experience that a still further improvement in accuracy of stacking loads can be obtained by adding a lateral movement to the apron. These two movements, combined with the forward and backward movement of the truck itself, permit the operator to shift the load for a limited distance in practically any direction. Consequently, the permissible zone of approach of the truck to a stack is expanded to within such wide limits that almost any operator, even a relatively inexperienced one, can bring a loaded lift truck up to a stack with sufficient accuracy on the initial approach. The latitude of movement of the load with a truck capable of both lateral and pivotal movement of the apron is such that all ordinary errors in approach can be fully corrected at the last moment, after the truck is stopped with its load over the stack upon which the load is to be set. The lessened requirements of skill and judgment by the truck operator and the savings in time and operation are very substantial.

In view of the foregoing, it is a general object of my invention to provide an improved apron frame for a fork lift truck that is simple and economical in construction and is sufficiently strong that it is not deformed by eccentric loadings.

It is also a general object of my invention to provide such a frame that is open to permit full visibility by the operator of the forks to facilitate loading and other operations of the truck.

Another object of my invention is to provide means for mounting an apron upon a lift truck in a manner to provide a complete range of movement of the forks but with a minimum reliance upon movement of the truck as a whole to accomplish this movement of the load.

These objects and advantages of my invention are attained in my improved type of apron assembly by providing a pair of vertically spaced, horizontally extending members which may be connected at their ends by other vertically extending elements to form an open, generally rectangular frame. These horizontally extending members are interconnected at a central point, intermediate their ends, by a tubular member which has a relatively thick wall. The tubular member is rigidly connected to the horizontal members so that the tubular member acts as a torque-resisting tube which holds the horizontal members in substantial parallelism and resists any tendency of them to rotate relative to each other as a result of eccentric loading of the forks.

This apron frame carrying the forks is pivotally mounted upon the offset to rotate around a vertical axis with respect thereto; and I preferably mount the offset upon the elevator in a manner to obtain lateral movement of the offset, and the parts carried thereby, with respect to the elevator.

How the above objects and advantages of my invention, as well as others not specifically mentioned herein, are attained will be more readily understood by reference to the following description and to the annexed drawings, in which:

Fig. 1 is a plan view, with the forward end of the forks broken away, showing my improved type of apron and offset member attached to the elevator of a conventional style of lift truck;

Fig. 2 is a vertical section on line 2—2 of Fig. 1;

Fig. 3 is an exploded isometric view of the apron, the offset, and the elevator; and

Fig. 4 is a force diagram showing the load

and forces resulting therefrom when a single fork is loaded eccentrically.

In Fig. 1, my invention has been illustrated as being applied to a conventional type of fork lift truck which is manufactured by the Hyster Company of Peoria, Illinois. This lift truck as a whole, is illustrated and described in greater detail in my co-pending application referred to above; but it is not believed that such a full disclosure of the details of the truck itself is necessary to a complete understanding of the present invention. This particular lift truck is typical of various ones to which my invention can be applied and is illustrated herein solely for the purpose of making a full disclosure of my invention; and it is to be understood that my invention is not necessarily limited to this particular make or type of lift truck.

At the forward end of the truck there is located a pair of spaced, telescopic uprights 10 which are interconnected at their upper ends by a cross bar 11. The two uprights form an upwardly extending track which guides the load-handling mechanism as the load is lifted or deposited. In order to raise and lower the load-handling mechanism, there is provided a centrally disposed hydraulic hoist 12 which rests at its lower end upon the frame of the truck, not shown, and at its upper end bears against the under side of cross bar 11. Hoist 12 is operated usually by means of hydraulic fluid under pressure from a pump, not shown, which serves to raise and lower the hoist in a conventional and well known manner, the hoist in turn raising and lowering uprights 10 and the load-handling mechanism.

The load-handling mechanism comprises generally, as may be seen best in Fig. 3, the elevator 15, offset 16, and the apron assembly 17 which includes forks 18 or other suitable load-carrying members. Elevator 15 is mounted on uprights 10 by means of bracket 20 which carries at each side one or more guide pulleys 21 that engage the uprights to direct the bracket and the load-handling mechanism in the up-and-down movement. Bracket 20 carries a pair of forwardly extending arms 23 which are fastened to the under side of the top transverse member 25 of the elevator to support it and connect it to the bracket. The lower transverse member 26 of the elevator is attached to bracket 20 by a pair of gusset plates 27 located one at each side of bracket 20.

In addition to the top and bottom transverse members 25 and 26 respectively, elevator 15 comprises a pair of end plates 28 which interconnect the transverse members to form an open, generally rectangular frame. The elevator also includes a pair of short, horizontally extending rods 29 which are mounted at their outer ends at end plates 28 and at their inner ends in bracket arms 23, or other suitable supports. The elevator as thus far described, is of conventional construction and the rods 29 ordinarily form a means for supporting a pair of conventional forks 18 directly upon the elevator; but it will be seen that in my improved construction the rods provide a means for connecting offset 16 to the elevator.

Offset 16 is a frame comprising spaced top and bottom plates 30 and 31 which preferably have downwardly and upwardly extending flanges 30*a* and 31*a* respectively to reinforce and stiffen them, and are interconnected by suitable vertical members 32 and 33. The somewhat triangular

appearance of plates 30 and 31 results from the fact that it is desirable to cut away the forward corners of the plates in order not to interfere with swinging movement of the load, and also because these forward corners are not essential to the structural strength of the offset. Two of the vertical interconnecting members are end posts 32 which are located near the outer ends of plates 30 and 31 and are provided at their upper ends with holes 34 to receive pins 35. As shown in Figs. 1 and 2, pins 35 pass through holes 34 and corresponding holes in lugs formed integrally with sleeves 36 slidably mounted one on each of rods 29. Vertical loads are transmitted from offset 16 through sleeves 36 to rods 29 on the elevator. Relative downward movement of offset 16 is limited by engagement of the bottom edge of flange 30*a* with the top edges of the lugs on sleeve 36, see Fig. 2, which engagement limits the rotational movement of the sleeves about either pins 35 or rods 29.

Sleeves 36 are free to slide along rods 29 in order to provide for lateral movement of the offset with respect to elevator 15. Such motion of translation is facilitated by a pair of rollers 40 which are horizontally spaced and bear against the forward face of the lower transverse member 26 of the elevator. Each roller 40 is mounted in a U-shaped bracket 41 carried on the up-turned flange 31*a* of the offset.

Relative lateral movement of the offset may be secured by any suitable means, as for example by an electric motor. However, I find it very convenient to use hydraulic means because the conventional lift truck is ordinarily provided with a pump from which oil under pressure may be obtained to provide the power for this purpose. There is provided a hydraulic cylinder 44 which is preferably pivotally connected to elevator 15, as by being attached at one end to bracket 45 which is pivotally connected at 46 to the top transverse member of the elevator. From the other end of cylinder 44 projects piston rod 47 which is then connected to arm 48 which in turn is rigidly connected to the top plate of offset 16. Piston rod 47 has attached to it a piston, not shown, which can be reciprocated within cylinder 44; and fluid under pressure is admitted into cylinder 44 at either side of the piston by means of two hydraulic lines 49 and 50.

The construction of cylinder 44 is conventional in all of its details, and any suitable type may be used. It will be evident that by admitting liquid under pressure through line 49, and at the same time discharging it from the cylinder through line 50, that the piston and piston rod 47 will be driven upwardly as viewed in Fig. 1. This causes the entire offset and forks 18 to be shifted toward the right of the truck operator as he looks forward toward the load. Admission of fluid through line 50 and discharge through line 49 moves the offset and forks 18 in the opposite direction. Since the oil is relatively incompressible, the offset may be locked in any adjusted position by blocking lines 49 and 50 to prevent flow of liquid therethrough in either direction.

Offset 16 serves as a member for connecting the apron assembly to the elevator, and for this purpose it can be modified in shape and construction as may be required to adapt it to any given type of lift truck. However, general principles of construction which are referred to herein may be followed to obtain all the advantages of the present invention. In addition, the offset moves the load forward of the conventional position

relative to the elevator so that forks 18 can overhang a stack of lumber or the bed of a truck. This latter is of especial value in loading ordinary trucks as it is necessary properly to balance their loads for transportation to the place of use and to permit safe and easy dumping of the loads. The front-to-rear depth of the offset is approximately one foot, which is sufficient to permit the apron assembly to swing from side to side an adequate amount, yet does not shift the load so far forward as to dangerously unbalance the loaded lift truck or cause it to get out of control when swinging a load.

It is desirable to reinforce offset 16 adjacent the connection thereto of the apron assembly; and for this purpose a centrally located, vertically extending member 33 is provided. This center reinforcing post is preferably channel shaped and may be made from a combination of plates or angles welded to plates 30 and 31.

Apron assembly 17 is generally rectangular in outline. It comprises a pair of top and bottom horizontally extending members 54 and 55 respectively which are vertically spaced and interconnected by suitable members. Top member 54 is preferably a channel or box member when viewed in cross section in order to give it sufficient strength to resist vertically applied loads, as will be more fully explained. The lower member 55 may be a plate if desired. The overall spacing between members 54 and 55 is slightly less than between plates 30 and 31 of the offset so that the two horizontal members of the apron assembly fit in between the plates of the offset, as shown in Fig. 2.

Frame members 54 and 55 are interconnected by tubular member 56 which is rigidly connected at its ends to the top and bottom members of the apron assembly. Tube 56 is located centrally of the assembly, midway between the ends of member 54; and since the tube is designed to be especially strong in torsion, it has relatively thick walls. The assembly may be further strengthened by the addition of end plates 58 joining horizontal members 54 and 55 at their ends.

In addition to its function as a torsion-resistant member rigidly interconnecting members 54 and 55, tubing 56 serves as a housing to receive pivot pin 60 by means of which the apron assembly is pivotally mounted on offset 16. It is preferable to counterbore tubing 56 from each end to receive a bushing 61 which forms a journal bearing at each end of the torque tube for the pivot pin. Plates 30 and 31 may be bored to receive pin 60 with a snug fit; or other suitable bearings may be used if desired. Thrust washer 64 is interposed between members 55 and 31 of the apron assembly and offset respectively and provides a thrust bearing upon which the apron assembly turns relative to the offset.

Since my improved apron assembly and offset are designed to be used as an attachment for standard types of lift trucks, the apron assembly is provided with means for mounting forks 18 which is a substantial duplicate of the conventional means supplied with the lift truck. For this purpose, a pair of rods 66 are provided on the under side of top horizontal member 54, the outer ends of the rods being supported by end plates 58 while the inner ends are held in short brackets 67. Rods 66 correspond in size and location to rods 29 provided on the conventional elevator, and forks 18 are slidably mounted on rods 66 in a conventional manner.

Forks 18 are of conventional design and each is a right-angularly shaped member with a forwardly extending, substantially horizontal leg on which the load L rests to be supported, as in Fig. 2. The other leg extends upwardly and is normally substantially vertical. It is provided at its upper end with a bore through which a rod 66 passes, the leg being suspended thereby. It will be understood that each fork is capable of a pivotal movement about its supporting rod 66, but that such movement of the fork is limited by engagement of the back side of the fork with the forward face of plate 55.

Although horizontal pivotal movement of apron assembly 17 may be obtained by other types of power elements, I prefer to provide hydraulic cylinder 70 which is pivotally connected at one end to elevator 15 by means of bracket 71 which is pivotally connected directly to the elevator. The piston rod 73 projecting forwardly from piston 70 is pin connected to bracket 72 which is rigidly attached to the apron assembly, as shown in Fig. 2. Hydraulic fluid under pressure is admitted to cylinder 70 through lines 74 and 75. The construction of this hydraulic cylinder is essentially the same as previously described and embodies a piston, not shown, on piston rod 73 which divides the interior of cylinder 70 into chambers. If liquid under pressure is admitted through line 75 and discharged through line 74, the piston rod is forced out of the cylinder and apron assembly 17 is rotated in a counterclockwise direction as viewed in Fig. 1. Reverse flow of the pressure flow in line 74 and out through line 75 results in retraction of the piston rod and swinging movement of the apron assembly in a clockwise direction. One advantage of the hydraulic operating means is that a load may be held in any rotational position by merely blocking flow of liquid through both lines 74 and 75, thus holding piston rod 73 in any desired position because of the incompressibility of the liquid within cylinder 70.

Because one end of the hydraulic cylinder assembly 70, 73 is attached to the elevator and the other to the apron assembly, it is necessary to provide some type of flexible connection to permit the lateral movement of the apron relative to the elevator. The pin or pivotal connections at both ends of cylinder assembly 70, 73 described permit such movement; and they also allow the apron to swing about pin 60 without causing the piston and piston rod to bind.

The stresses in the apron assembly, and more especially in torque tube 56, can be readily understood by reference to Fig. 4. The most severe condition occurs when the loading is entirely eccentric, that is when only one fork 18 has a load on it. This may occur accidentally or on purpose. Assuming only one fork is loaded it is simple to analyze the resulting stresses by considering the one fork alone.

When one fork 18 is loaded with a load L, as shown in Figs. 3 and 4, it tends to rotate counterclockwise (as viewed in Fig. 4) about rod 66 under a given moment. This condition is exactly the same as if a force M_1 were applied to the upstanding leg of the fork at the level of member 55, the magnitude of the force M_1 being sufficient to produce an equal moment about the axis of rod 66. Since this moment is resisted by the bearing of the fork against the bottom member 55 of the frame assembly holding the fork fixed in place, the force M_1 is opposed by an equal and opposite reaction designated as R_1.

The applied load L also tends to produce counterclockwise rotation of the fork about its point of engagement with fixed member 55. This second moment could be reproduced by the application of a second force designated as M_2 applied at the upper end of the fork at the level of rod 66, the magnitude of the second force M_2 being enough to produce a moment equal to that produced by the applied load L. Of course the force M_2 is opposed by an equal and opposite reaction R_2 also applied at the level of shaft 66.

It will thus be seen that members 54 and 55 are each subjected to a horizontal force M_2 or M_1 respectively, the forces being oppositely directed. The forces M_1 and M_2 being at the same side of tube 56 and applied through one-half the length of members 54 and 55 twist the ends of tube 56 in opposite directions as indicated by arrows 80 and 81 respectively. The opposing reactions R_2 and R_1 are produced for the major part, if not substantially entirely, by the resistance in torsion of tube 56; and for this reason the walls of tube 56 are made sufficiently thick and heavy that the tube is able to develop adequate resistance to torsional loading without buckling or bending. In a typical case, a tube having a three inch internal diameter with a wall thickness of one inch has been found to resist an eccentric loading of over ten tons applied to one fork 18, without causing the apron assembly to deform permanently.

The immediately preceding discussion has assumed a load L applied to only one fork, specifically the near fork 18 as seen in Fig. 3. The same stresses are developed if a similar load is applied to the other fork, i. e. the far fork as seen in Fig. 3, except that the forces M_1 and M_2 then are both at the other side of torsion-resistant member 56 so that the relative twist is opposite in direction to the arrows 80 and 81. It follows that if both forks are loaded equally the forces M_1 at the two sides of tube 56 are equal and lower frame member 55 is then in bending just like a simple beam. Likewise the forces M_2 are equal and upper frame member 54 is loaded like a simple beam. The net or resultant forces twisting tube 56 are reduced to zero and there is then no torsion in the tube. This is an ideal condition seldom realized; and the apron is designed to resist extreme conditions.

In designing the frame, it is preferable to make tube 56 heavy enough to carry the entire expected torsional load, although the addition of end posts 58 adds to the strength of the frame. This design is preferred since it permits elimination, or substantially so of heavy diagonal braces that obstruct or cut off the operator's vision of the forks and his loads. At most, only relatively light braces are required, and these are mainly to carry the vertical bending in the frame. Since forks 18 are suspended from the top member 54, the latter is designed to carry the applied vertical load as a beam. By adding end plate 58, the entire frame becomes a truss, with 55 the lower chord, to carry vertically applied loads.

As a consequence of this design, the apron, the offset and the elevator are all substantially open frames with no side plate or heavy braces to cut off the operator's vision. Post 33 in the offset is back of tube 56 so that both members present minimum visual obstruction.

It will be realized from the foregoing that various changes may be made in my improved apron construction without departing from the spirit and scope of my invention. Consequently, I wish it understood that the above description is considered to be illustrative of, rather than limitative upon, the appended claims.

I claim:

1. In a lift truck, the combination comprising: an elevator; means mounting the elevator on the truck for upward movement thereon; an offset frame; sleeve means slidably supporting the offset frame on the elevator for horizontal movement relative to the elevator; an apron including a pair of spaced horizontally extending frame members and a tubular member rigidly interconnecting said frame members; a pivot pin passing through the tubular member and pivotally mounting the apron on the offset to swing about a vertical axis; and load carrying means attached to the apron.

2. An apron assembly for a lift truck adapted to be pivotally mounted on the truck, comprising: an upper frame member and a lower frame member, said members being vertically spaced and horizontally extending; a vertically extending torsion-resistant member located centrally of the frame members rigidly interconnecting the two horizontal frame members and constituting substantially the entire means for holding the frame members against relative rotation about the axis of the torsion-resistant member; and load supporting means comprising a pair of angular forks connected to the upper frame member one at each side of the torsion-resistant member, and bearing against the lower member, each fork when loaded producing in the upper and lower frame members oppositely directed horizontal thrusts tending to rotate the upper and lower frame members in opposite directions about said axis.

3. An apron assembly as in claim 2 in which the torsion-resistant member is tubular with relatively thick, heavy walls.

4. An apron assembly for a lift truck adapted to be pivotally mounted on the truck, comprising: a pair of vertically spaced, parallel, horizontally extending frame members; a torsion-resistant member extending vertically between the frame members and rigidly connected at its ends to the frame members centrally thereof; pivot means for mounting the apron assembly upon the truck to swing about the axis of the torsion-resistant member; and a pair of load carrying angular forks suspended from the upper one of the frame members, one at each side of and spaced from the torsion-resistant member, each fork extending forwardly of the frame members and engaging the lower one of the frame members to produce a rearwardly directed thrust thereagainst whereby a load on only one fork tends to twist the frame members oppositely about said axis, said twist being resisted by the torsion-resistant member.

5. An apron assembly for a lift truck adapted to be pivotally mounted on the truck, comprising: a pair of vertically spaced, horizontally and laterally extending frame members each having a centrally located hole through the member; a relatively thick-walled hollow tube rigidly connected to each of the frame members at said hole in the frame member to receive a pivot pin passing through said holes and establishing the axis of pivotal movement of the apron assembly; and a pair of load carrying angular forks suspended from the upper one of the frame members, one at each side of the tube, each fork extending forwardly of the frame members and thrusting rearwardly against the lower one of the frame members whereby a load on only one fork tends to twist the frame members oppo-

sitely about said axis and the tube resists such twisting movement.

6. In a lift truck, the combination comprising: an elevator; means movably mounting the elevator on the truck for upward movement thereon; an offset frame mounted on the elevator and movable therewith; an apron including a pair of vertically spaced, horizontally extending frame members and a torsion-resistant member extending vertically between and rigidly interconnecting the frame members centrally thereof, said torsion-resisting member being tubular with relatively thick, heavy walls; a pivot pin passing through the torsion-resistant member and elements of the offset frame to pivotally mount the apron at a forward position on the offset frame at which the lateral ends of the apron are positioned forwardly of the offset frame; and load carrying means mounted on the apron including a pair of angular forks one at each side of and spaced laterally from the torsion-resistant member, each fork producing a forward thrust in the upper frame member of the apron and a rearward thrust on the lower frame member of the apron whereby a load on only one fork tends to twist the two frame members oppositely about the torsion-resistant member.

7. An apron assembly for a lift truck adapted to be pivotally mounted on the truck at the forward end thereof, comprising: a frame having a pair of horizontal, vertically spaced frame members extending transversely of the truck; a vertically extending tubular member rigidly connected at each end to one of said horizontal frame members centrally thereof to maintain the horizontal members in substantial vertical alignment; pivot means centrally of the frame including a pivot pin passing through the tubular member mounting the frame on the truck for a limited pivotal movement in a horizontal arc, the horizontal frame members being unsupported at their rear sides laterally of the pivot means to permit such movement; and load supporting means on the frame including a pair of angular forks projecting forwardly of the frame one at each side of and spaced from the pivot means, each fork being suspended from the upper frame member and bearing against the front side of the lower frame member.

8. In a lift truck, the combination comprising: an upwardly extending track; an elevator movably mounted on the track for upward movement thereon; an offset frame mounted on the elevator for lateral movement relative thereto; an apron assembly pivotally mounted on the offset frame to swing about a generally vertical axis relative to the offset, the apron assembly including a frame and a pair of laterally spaced load carrying forks mounted on the frame to project forwardly therefrom; operating means for swinging the apron assembly about its pivotal mounting; and pivot means pivotally connecting the operating means to both the apron and the elevator.

THOMAS N. MELIN.

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