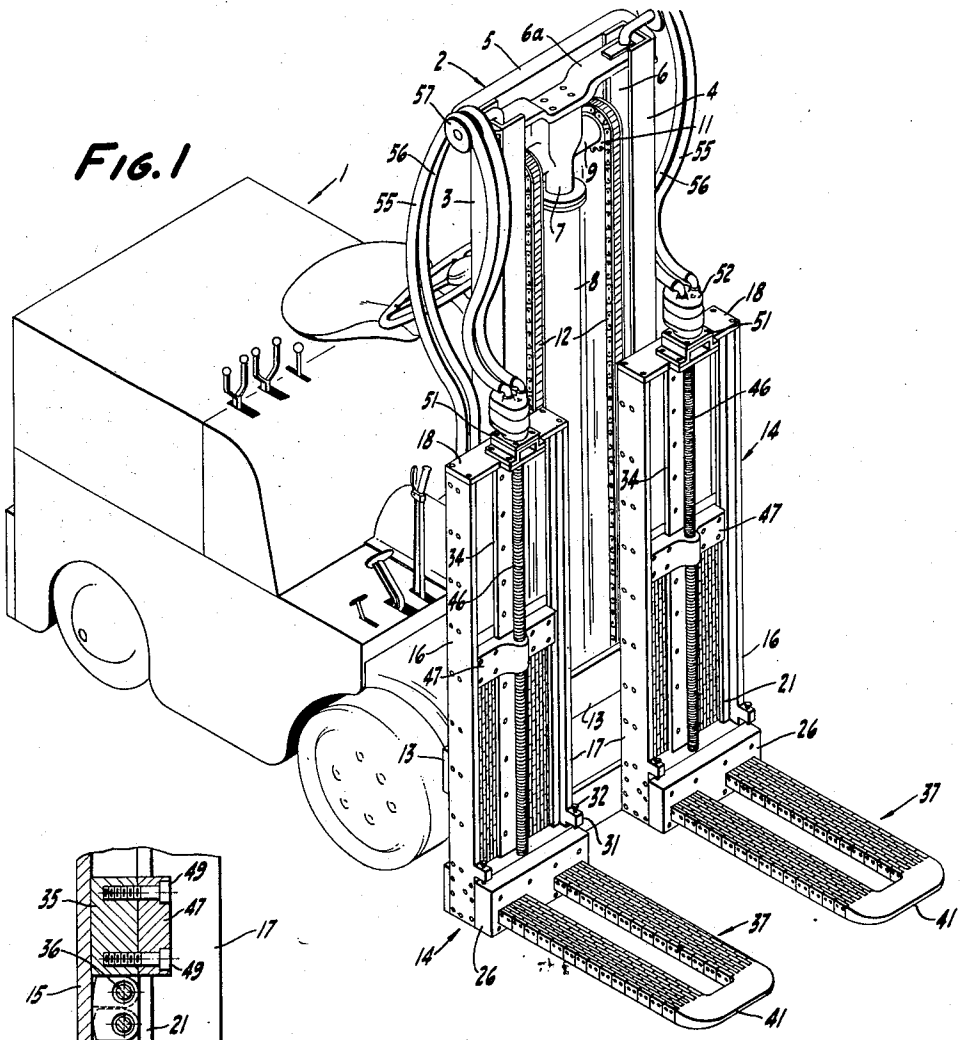
Nov. 6, 1951 S. D. LAPHAM 2,574,045

FORK LIFT TRUCK

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FIG. 1



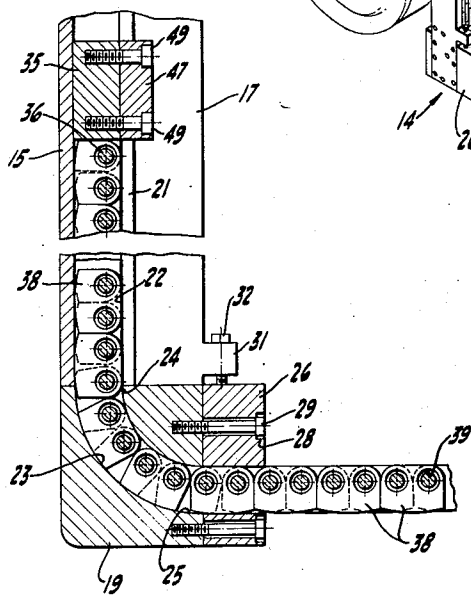


FIG. 2

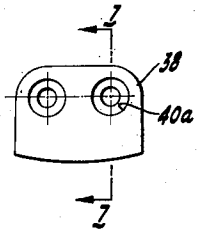


FIG. 6

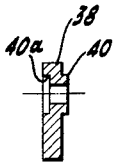


FIG. 7

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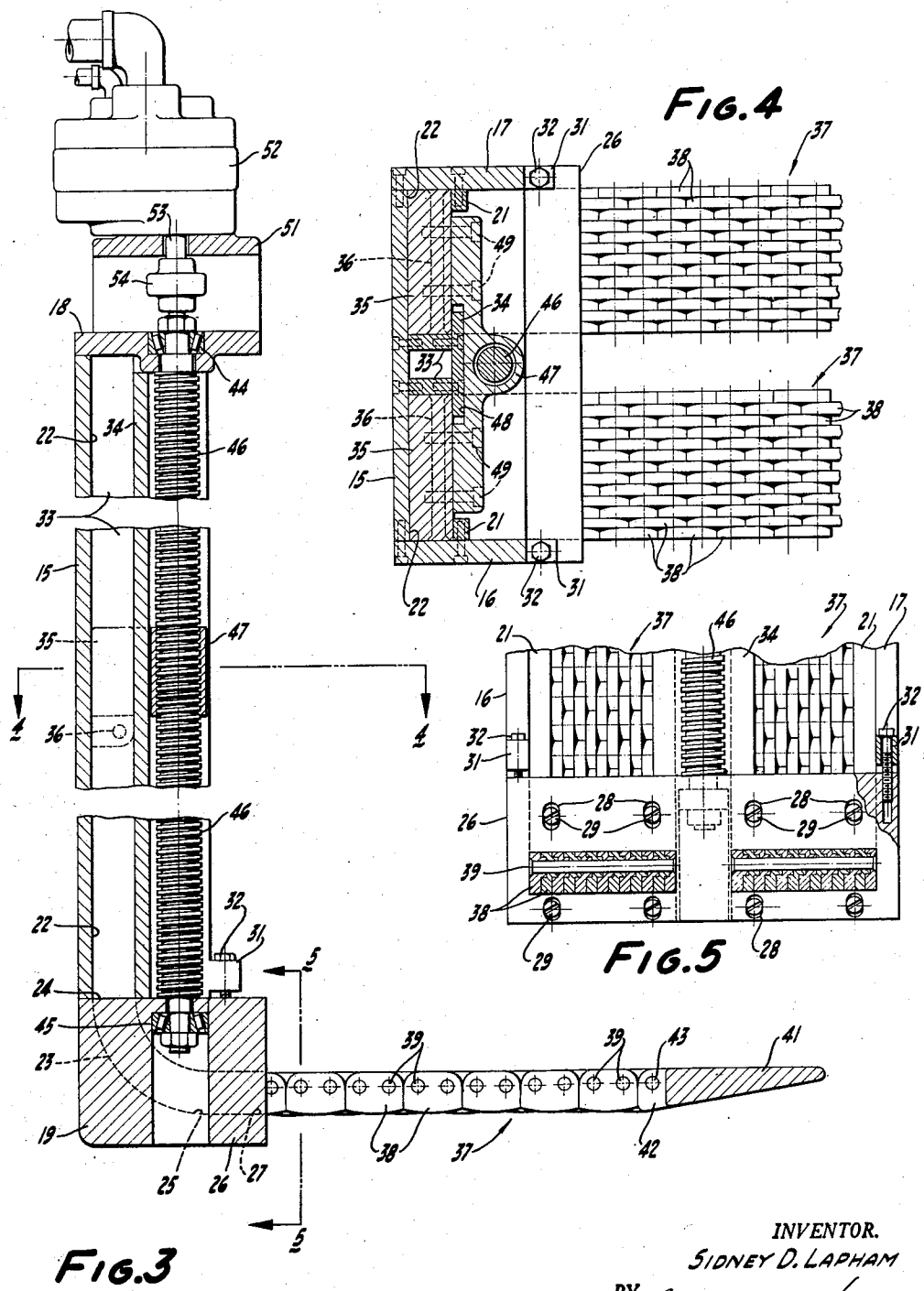


FIG. 3

FIG. 4

FIG. 5

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UNITED STATES PATENT OFFICE

2,574,045

FORK LIFT TRUCK

Sidney D. Lapham, Martinez, Calif.

Application February 2, 1948, Serial No. 5,752

10 Claims. (Cl. 214—113)

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This invention relates to, and in general has for its object the provision of a fork lift truck and a retractable fork therefor.

Industrial fork trucks presently available are provided with a vertically movable and tiltable carrier on which is mounted a fixed or hinged load supporting fork. Since the length of the fork must be included in the over-all length of such a truck, it readily can be seen that its maneuverability is thereby appreciably limited and that its use requires additional operating space, some of which could otherwise be used as valuable storage space.

More specifically then, the object of this invention is the provision in an industrial truck of a retractable articulated fork mounted in a fork carrier supported by said truck for vertical and tilting movement with respect thereto.

A further object of this invention is the provision of a new and novel link, a number of which can be pivoted together in staggered relation to form a belt capable of sustaining a load cantilever fashion.

The invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description where that form of the invention which has been selected for illustration in the drawings accompanying and forming a part of the present specification is outlined in full. In said drawings, one form of the invention is shown, but it is to be understood that it is not limited to such form, since the invention as set forth in the claims may be embodied in a plurality of forms.

Referring to the drawings:

Fig. 1 is an isometric projection of an industrial lift truck embodying the objects of my invention.

Fig. 2 is an enlarged fragmentary section taken through one of the fork carriers immediately adjacent and parallel to one of its articulated retractable forks.

Fig. 3 is a vertical section taken through one of the fork carriers along the longitudinal axis of its associated fork retracting screw.

Fig. 4 is a horizontal section taken through the fork carrier on the section line 4—4 of Fig. 3.

Fig. 5 is a fragmentary vertical section taken on the section line 5—5 of Fig. 3.

Fig. 6 is an enlarged side elevation of one of the fork links.

Fig. 7 is a vertical section taken on the line 7—7 of Fig. 6.

As shown in these various figures the objects of my invention have been embodied in an industrial lift truck generally designated by the

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reference numeral 1, of conventional construction and on which a mast, generally designated by the reference numeral 2, is mounted for tilting movement with respect thereto.

The mast 2 includes a pair of laterally opposed guide channels 3 and 4 fastened at their upper ends to a cross-channel 5. Slidably disposed within the guide channels 3 and 4 is a rectangular frame 6 including an upper cross arm 6a, and secured intermediate the ends thereof is a piston rod 7 provided at its lower end with a piston (not shown) arranged to slide in a cylinder 8. The cylinder 8 is mounted on the mast 2 between the guide channels 3 and 4 so as to move bodily therewith. Formed integral with the upper end of the piston rod 7 and forming a T therewith is a transverse sleeve 9, and mounted therein is a shaft (not shown). Journaled on each end of this shaft is a sprocket wheel 11, and passing over each of these sprocket wheels in mesh therewith is a chain 12. The forward lower end of each chain 12 is anchored to a cross arm 13 arranged to slide over the forward faces of the guide channels 3 and 4 and which may be considered as a mounting for supporting the tines of a lift fork. In accordance with standard practice, the cylinder 8 communicates with a source of fluid under pressure such as a pump for lowering and raising its piston and the associated piston rod 7, suitable valves being mounted on the truck cab for controlling the flow of fluid in the desired direction. Since the lower rear ends of the chains 12 are anchored to the lower ends of the guide channels 3 and 4, the elevation of the frame 6 in response to the upward movement of the piston rod 7 over a predetermined distance *d*, will result in the elevation of the cross arm 13 through a distance equal to 2*d*.

The lift truck thus far described, is of more or less standard construction and operation, and is normally provided with rigid, forwardly extending forks, these forks being mounted on the cross arm 13 or some equivalent structure.

However, in carrying out the objects of my invention, a fork carrier generally designated by the reference numeral 14, is bolted to each end of the cross arm 13 on the forward face thereof. Each of these carriers includes a rectangular back plate 15, opposed side plates 16 and 17, a top plate 18 and a block or foot 19. Fastened to the inner face of each of the side plates 16 and 17 is a cleat 21, these cleats and the back plates 15 forming vertically extending fork guide channels 22. Formed in each foot 19 is an arcuate slot 23 having an upper end 24 in alignment with the

channels 22 of its carrier 14 and a forwardly extending end 25. Disposed over the front face of each foot 19 is a vertically adjustable wear plate 26 provided with a horizontally extending slot 27 forming a continuation of the forwardly extending end 25 of the arcuate slot 23. Each of the wear plates 26 is provided with vertically elongated slots 28 for the reception of bolts 29 threaded to the foot 19. Extending forwardly from each of the side plates 16 and 17 immediately above the wear plates 26 is an ear 31 and extending through each ear is a set screw 32 threaded to its associated wear plate for determining the vertical position of said plate.

Bolted to the back plate 15 on either side of the longitudinal center line, and extending substantially the full length thereof is a cleat 33 and bolted to the forward edges thereof is a plate 34 (see Fig. 4). Slidably disposed within each of the channels 22 is a block 35, these blocks being held in place by the cleats 21 and plate 34. Fastened to the lower portion of each of the blocks 35 by a pin 36 is an articulated and retractable fork generally designated by the reference numeral 37 and which is arranged to slide through one of the channels 22, through one of the arcuate slots 23, and through one of the slots 27 formed in its associated wear plate 26. Each of the retractable forks 37 is made up of a number of staggered or offset links 38 pivoted to each other by pins 39. Formed on one side of each link 38 about each of its pins 39 is a boss 40, the opposite side thereof being provided with concentric recesses 40*a* in which the bosses of the laterally adjacent and staggered links are receivable. The back or lower edge of each link 38 is curved on a radius equal to the outer radius of the arcuate slot 23 but has substantially square corners, whereas the corners of the upper or outer edges of each link are formed on a radius equal to one-half the distance between the axes of the pins 39. In this connection it should be noted that the distance from either end of the link to the axis of the adjacent pin is equal to one-half the distance between the axes of the two pins passing through the link. By resorting to this construction, a fork is provided which will bend freely in one direction but which in the opposite direction will not bend beyond a common straight line or reference plane. In this connection it is to be noted that the pins 39 are located above or forward of the longitudinal center lines of the links so that the major portion of their end edges form extended lever arms by which each link is supported cantilever fashion from the link immediately behind it in a straight line or plane. Secured to the forward ends of the front terminal links of each adjacent pair of forks is a wedge shaped toe 41, the rear edge of each toe being provided with fingers 42 interdigitated with the terminal links and pivoted thereto by a pin 43.

Mounted respectively in the top plate 18 and in the block or foot 19 are bearings 44 and 45, and journalled therein is a screw 46. Threaded on the screw 46 is a cross bar 47 formed on its rear face with a channel 48 for the accommodation of the plate 34 (see Fig. 4), and secured at each end to slide blocks 35 by bolts 49. It will, therefore, be seen that rotation of the screw 46 will produce a vertical movement of the cross bar 47 and a corresponding movement of the retractable forks 37.

Fastened to each of the top plates 18 is a bracket 51 and mounted on each of these brackets is a fluid motor 52 of conventional construction including a drive shaft 53 aligned with one of the screws 46 and secured thereto by a coupling 54. Communicating with each of the motors 52 in accordance with standard practice are a pair of flexible hoses 55 and 56, these hoses being supported by pulley wheels 57 mounted on the cross arms 6*a*. Although not shown, the hoses 55 and 57 are connected through suitable control valves with a source of fluid pressure such as the pump normally carried by the truck 1 and used for actuating the fork carrier, or with an independent pump.

By selecting the direction of the flow of fluid through the motors 52, the screws 46 can be rotated in either direction to thereby selectively extend or retract either or both of the forks 37, it being contemplated that the motor 52 for each of the two forks shown, be controlled by its own and independent valve.

To pick up a load on the retractable forks above described, the truck with the forks in their retracted position is advanced to the load, its brakes set, and then the forks are advanced to a position under the load. This having been done, the fork carrier is manipulted in the usual manner to tip the load slightly backward and to elevate it clear of the pallet on which it was resting. To deposit the load on a receiving pallet, the fork carrier is simply lowered until the load rests on the pallet, and with the truck brakes set, the forks are retracted away from the load and into the carrier.

I claim:

1. A lift truck comprising: a vertically movable fork carrier provided with a fork-way therein including a curved forwardly extending lower portion; an articulated fork movable within said fork-way, said fork being bendable from a reference plane only in one direction; and power means mounted on said truck for paying out and retracting said fork.

2. A lift truck comprising: a vertically movable fork carrier; a fork-way including a curved lower portion mounted on said fork carrier; an articulated fork mounted in said fork-way for movement therein, said fork being formed by two sets of coplanar links, the links of one set being offset with respect to the links of the other set and said fork being bendable from a reference plane only in one direction.

3. A lift truck comprising: a vertically movable fork carrier provided with a fork-way including an outwardly directed curved lower portion; a link belt fork mounted in said fork-way for movement therein, said fork being bendable from a reference plane only in one direction; a screw actuated cross head mounted in said fork-way above said fork and attached thereto; and a motor mounted on said truck for rotating said screw in either direction.

4. A lift truck comprising: a tiltable elevator; a vertically movable fork carrier mounted on said elevator, said carrier being provided with a fork-way having a forwardly curved lower end; a link-chain fork mounted in said fork-way for movement therein in either direction, said fork being bendable from a reference plane only in one direction; and means mounted on said truck for moving said fork through said fork-way in either direction.

5. A lift truck including a vertically movable fork carrier provided with a curved arcuate fork retainer; a linked fork accommodated in said retainer and movable therethrough, said fork being constrained by the formation of its links from

bending in one direction beyond a straight line but being free to bend in the opposite direction in conformation with said curved fork retainer and means mounted on said truck for moving said fork through said retainer in either direction.

6. A lift truck such as defined in claim 1 wherein said articulated fork includes a first set of links aligned in rows and columns interdigitated with a second set of coplanar links likewise aligned in rows and columns and forming therewith a staggered, symmetrical pattern, the rear ends of the links in each row of each set of links being pivoted to the forward ends of the links in each row of the other set of links, the corners of each of said links on one side of said fork being curved and the corners of each of said links on the opposite side of said fork being substantially square.

7. An articulated load supporting member comprising: first and second sets of links arranged in rows and columns, the links of said first set being staggered with respect to the links of said second set, the trailing ends of the links in each row of links being pivoted by a pin to the leading ends of the links in the next succeeding row of the links, the adjacent ends of links in each set meeting in a common line when said member is disposed in a common plane, and the corners of all of said links on one side of said member being curved so as to permit said member to bend in one direction with respect to said reference plane.

8. An articulated member for supporting a load cantilever fashion, comprising: a belt made up of identical links pivoted together by means of pins in columns and staggered rows wherein each link is provided at each end thereof with a bore for receiving one of said pins, and the distance between the axes of said bores is substantially equal to twice the distance between the axis of each bore and the adjacent end of the link, and wherein the upper corners of said link lie within an arc formed on a radius equal to the distance between one of said bores and the adjacent end of said link, and having its center on the axis of its adjacent bore.

9. A link forming a belt bendable only in one direction beyond a reference plane and capable of sustaining a load cantilever fashion comprising: a generally rectangular metal block having opposed faces, opposed ends and a top and bottom, and formed with a pair of parallel pin receiving bores extending through said faces on a common horizontal center line lying above the horizontal center line of said block, the distance d between the axis of either of said bores and the adjacent end of the block being equal to one-half the distance between the axes of said bores, the upper corners of said block being cut off so as to lie completely within an arc having a center lying on the axis of the adjacent bore and formed on a radius equal to d.

10. A link such as defined in claim 8 wherein said bores are counter-bored on one face of said block, and wherein said block on its opposite face is provided with bosses surrounding each of said bores and arranged to mate with the counter-bores of other and identical links.

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