

April 7, 1959

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2,880,897

SIDE OPERATING DIE HANDLING INDUSTRIAL TRUCK

Filed Aug. 26, 1957

3 Sheets-Sheet 2

Fig. 2

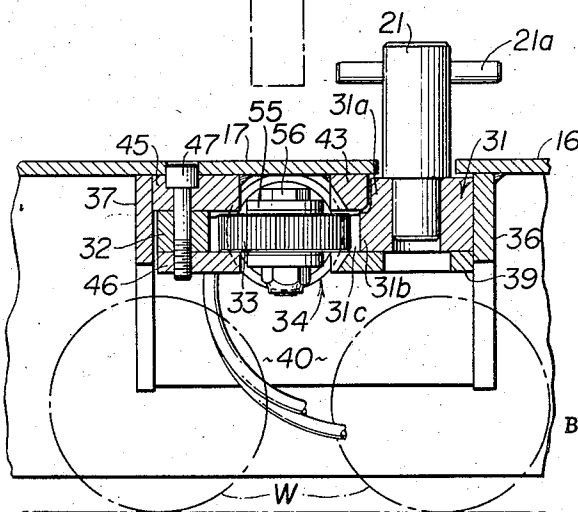
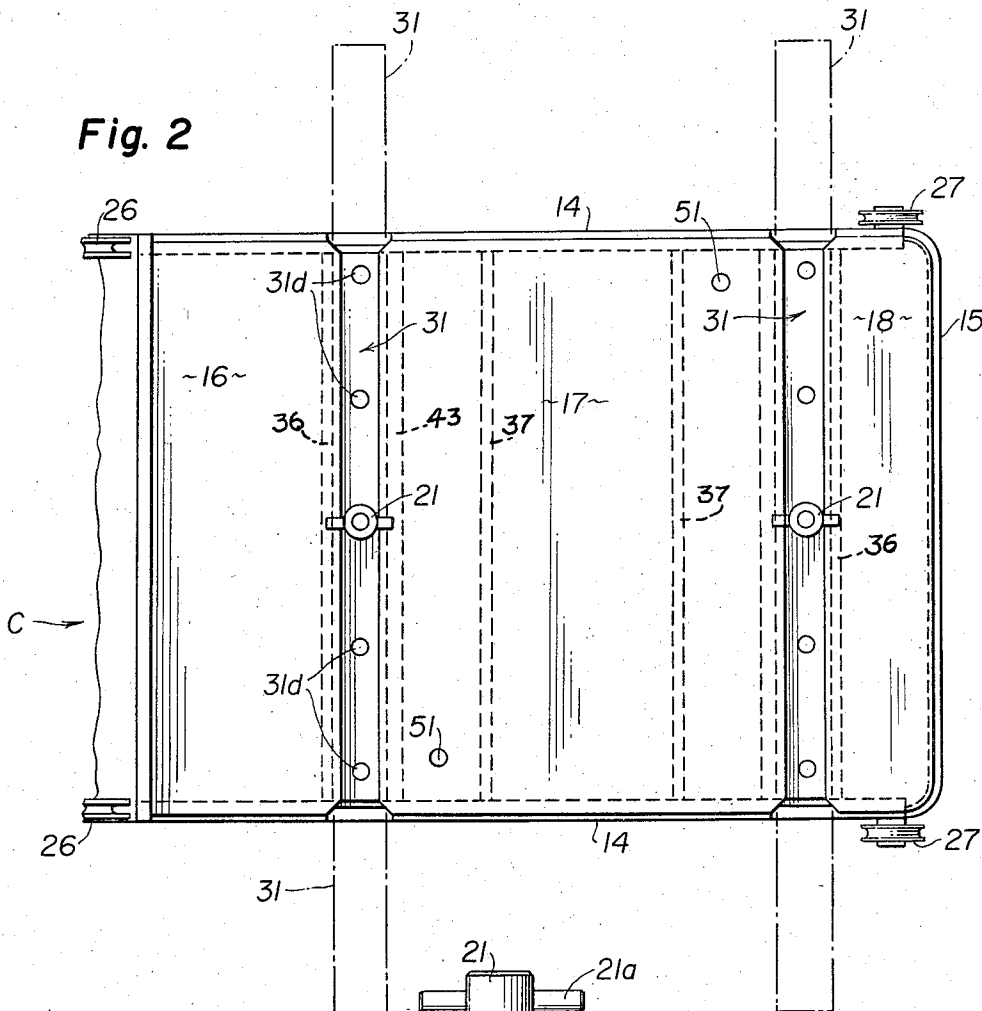


Fig. 5

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SIDE OPERATING DIE HANDLING INDUSTRIAL TRUCK

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Application August 26, 1957, Serial No. 680,095

9 Claims. (Cl. 214—514)

The present invention is concerned generally with an industrial truck for handling heavy dies and like loads, and more particularly with industrial lift truck.

Industrial trucks of various types have included mechanism adapting the truck for manipulation of heavy loads such as die blocks being removed from or replaced in presses and the like. Diverse arrangements of hydraulic mechanism for dragging a die out of a press onto an elevatable platform of a lift truck and for moving the same toward position in a press are known to the prior art, particularly in trucks designed for end loading and unloading of a die by such means. Further trucks are known which have used winch and cable type devices with cable sheaves disposed at appropriate locations on the truck or truck elevator platform for directing cables for suitable engagement with the die to be drawn on or off the truck platform.

Because of the simplicity of set-up operations for a particular die manipulation and the avoidance of cable reeving over pulleys and the like, hydraulic cylinder actuated mechanisms are preferable for the specific die manipulating means used on trucks of this character. However where side loading or unloading of a die has been desired the hydraulic mechanism proposed for such purposes has usually involved either encumbering of the platform area of the elevator carriage itself, necessitating a larger platform structure than would otherwise be necessary; and in the case of proposals for location of the hydraulic mechanism on the elevator carriage but beneath the platform, it has appeared that the requisite structure for handling the loads and masses anticipated entailed a rather high elevation of the platform in its lowermost position in order to clear frame or chassis elements of the vehicle proper.

By the present invention there is provided a side operating industrial lift truck adapted to handle relatively large loads such as die blocks which permits a relatively compact structure in the platform, and thereby attainment of a low position of the platform surface. Further it has been found desirable at times in trucks of this character to have "outriggers" or extension arms projecting from the truck platform to serve as load supports at least partially bridging a gap between the platform and the site to or from which the load is being moved. The mechanism of the present invention inherently provides such outriggers under certain conditions of operation without encumbering the skirts or sides of the truck with structures which even when retracted from normal operating position still involve an undesirable projection from the vehicle.

These desired characteristics are achieved in the present invention by the provision of a transverse slideway included in the structure of the die elevator platform, and a slide element therein which has a neutral position entirely within the confines of the die platform but is movable in the slideway from one end or the other to protect outwardly from either side of the truck platform. The slide element is part of a hydraulically actuated differential

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rack mechanism including a rack formation on the slide, a fixed rack element in parallel spaced relation thereto and a double-acting hydraulic cylinder unit with one end secured relative to the truck platform and carrying on its piston rod pinion means meshing with the two rack elements. By the differential action, extension or contraction of the cylinder unit causes multiplication of motion in the slide element, which is in a two to one ratio to the piston movement even with a simple pinion.

Further the entire mechanism is located beneath the platform surface, excepting anchor and abutment means on the slide projecting above the platform through a slot above the slide. Provision is made for changing location of such means relative to the slide. The racks and cylinder unit are disposed in approximately horizontal parallel relation to minimize the vertical space required therefor beneath the truck platform and hence permitting a low level position of the lowered platform. Preferably at least two such hydraulically actuated mechanisms are used, disposed in spaced parallel relation.

The general object of the present invention is then improvement in an industrial truck for handling heavy dies or like loads. Another object is the provision of a die handling industrial lift truck of the side operating type wherein an actuating mechanism for side loading and unloading means is disposed entirely beneath the lift carriage platform surface. Another object is the provision of a side loading industrial lift truck for die handling and the like with actuating mechanism beneath the truck platform, wherein such mechanism is of compact form permitting attainment of low platform levels. Another object of the invention is the provision of a die handling mechanism for a lift truck wherein the mechanism itself inherently provides outrigger support for a load under certain conditions without encumbering the marginal or skirt regions of the platform with outwardly projecting structures. Other objects and advantages of the invention will appear in the following description and the drawings wherein:

Fig. 1 is a side elevational view of a truck embodying the present invention;

Fig. 2 is a fragmentary plan view of the elevator carriage platform;

Fig. 3 is a detailed plan view of the die handling mechanism;

Fig. 4 is an elevational view of certain parts of the mechanism taken substantially as indicated by the line 4—4 in Fig. 3; and

Fig. 5 is an irregular sectional view taken substantially as indicated by the line 5—5 in Fig. 3;

Fig. 6 is similar to Fig. 5, for a modification with great motion multiplication; and

Fig. 7 is similar to Fig. 6 for a further modification with a motion ratio less than that of Figs. 1—5.

As an example of one embodiment of this invention there appears in Fig. 1 a known type of industrial lift truck comprising a self-powered vehicle V having a pair of drive wheels D, paired steering wheels W, here in four pairs, an operator's station O with vehicle operating controls disposed adjacent thereto for convenient manipulation by an operator standing therein, and a load elevator mechanism L with a vertically movable load carriage C. For the sake of convenience of later description of structure and operation in die or other load handling, the left end of the truck, as viewed in Fig. 1, will be considered the rear and the right the front, irrespective of what is considered the front and rear in normal vehicular movement.

In the elevator mechanism L the carriage C is shown as supported and guided in its vertical movement by a pair of laterally spaced parallel heavy uprights 10 rigidly secured to the vehicle frame or chassis, the carriage be-

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ing provided with a top pair of roller wheels 11 and a bottom pair 12 rolling respectively upon the back and front sides of respective uprights. The carriage C (see also Fig. 2), is of a usual welded plate rigid frame construction, including members supporting the rollers 11, 12; side skirt members 14 laterally spaced outboard of the uprights 10; a front skirt 15 member joining the side skirts; and, extending across vertical plates 36, 37 as beam members joining the side skirts, horizontal plates 16, 17, 18 forming a load supporting platform. Adjoining pairs of plates 16, 17, 18 are mutually spaced at 20, 20 to form corresponding transverse slots accommodating the transversely shiftable stanchions 21 of the hydraulically operated side-operating load or die handling system or mechanism of the carriage hereinafter described. Other elements of the carriage frame will be referred to in description of the side operating load handling mechanism. In identical locations on opposite sides of the carriage a respective end operating load mechanism E is provided.

Before detailing the load handling mechanism it may be here noted that the vehicle may be powered by electric motor and battery or internal combustion engine driving systems with corresponding transmission and drive control means; and any suitable vehicle frame, steering system and elevator mechanism may be used, as may be determined from general design considerations of the character, weight and size of the contemplated loads, the environment of operation, and such factors. Thus hydraulic steering means may be used in the vehicle; and vertically acting hydraulic cylinder means interposed between the vehicle frame and carriage C for powering the elevator mechanism. In any event the means for moving the carriage vertically between the lowermost and uppermost carriage platform positions indicated respectively by the solid lines and dashed horizontal line of Fig. 1 is such that the platform may be maintained at those extreme and all intermediate positions. Since elevator motor and control mechanism are well known to the art, these are not further detailed.

Each end-operating winch mechanism E comprises a motor and gearing unit 25 mounted on the side of the carriage adjacent the corresponding upright and a windlass drum 26 driven on an axis transverse of the truck by unit 25 located at a position spaced vertically above the carriage platform but lying inside of the span of the platform. With a cable 29 passed around a load and having opposite ends wound on the respective drums, or by individual cables secured to the load and to respective drums, obviously by operation of the winches a load may be drawn endwise onto the platform. By means of pulley sheaves 27, 27a rotatably mounted on the side skirts respectively at the front and rear of the carriage, a single cable or individual cables in like fashion engaging a load on the platform can be so directed as to move a load endwise off the platform. Rotary hydraulic or electric motors may be used for the mechanisms E, preferably independently operable.

The detailed structure of the mechanisms S, whereby the upright stanchions 21 are shifted transversely across the carriage platform in the slots 20 provided respectively between the parallel spaced edges of plates 16, 17 and plates 17, 18 appears in Figs. 3-5 inclusive for the rear mechanism, which alone is described since the two are identical except for a possible inversion of positions of elements. Apart from the stanchion 21, the elements of each mechanism S—namely a movable slide and rack member 31, a fixed rack member 32, a pinion 33 engaged therebetween as a differential rack-and-pinion motion, and a hydraulic cylinder unit 34 the movable part of which carries the pinion—are disposed beneath the platform in locations clearing both the steering mechanism and wheels W and the vehicle frame members F (shown in dashed outline in Figs. 3-5).

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A slideway for member 31 is formed beneath the platform slot 20 by the front face of carriage frame member 36; a bottom plate 39 secured along one edge to member 31 and endwise to spacer plates 40, 41 welded between and to the transverse frame members 36, 37 and to the inner sides of respective skirts; and a bar 43 parallel to 36 welded to the bottom of plate 17, engaging a rabbet 31a of the slide member. The longitudinal rim or flange 31b formed below the rabbet and projecting partway into the space between the bar 43 and the parallel margin of bottom plate 39 spaced therebeneath, is provided over about half its length with the rack formation 31c. The skirts 14 are apertured correspondingly to the cross section of slide or rack member 31 to permit the same to be extended from the slot laterally of the carriage platform to one side or the other as indicated by the dashed outlines 31 in Fig. 2.

The movable rack is provided with a series of spaced vertical round apertures 31d, here shown as five, located along the slot centerline, adapted in size to receive the reduced lower end of a stanchion 21, whereby the stanchion (or a plurality of them if desired) may be manually shifted among the several corresponding positions on the slide. The stanchion near its upper end is provided with a cross pin 21a to retain cables or the like.

The fixed rack member 32 is disposed parallel to the movable rack formation 31c, and opposite the "neutral" position thereof (i.e., the movable rack formation position when the slide member as a whole is centered with respect to the platform), the racks proper being approximately of the same effective length. The fixed rack 32 is sandwiched and held in such position between a spacer plate 45, welded to the underside of plate 17 and to the rear face of 37, and a bottom plate 46 secured by a plurality of longitudinally spaced bolts 47. The plates 45 and 46 project beyond the fixed rack formation, and accordingly, the bottom face of the horizontally disposed pinion 33 is supported at diametrically opposite regions upon the opposed spaced parallel longitudinal marginal areas of the bottom plates 39 and 46. Suitable lubrication channels and nipples (not shown but well known to the art) are provided for the slide structure racks and pinion.

The hydraulic cylinder unit 34, includes the cylinder 50 pivotally mounted at one end by vertical trunnions 51, 51 received in corresponding apertures formed in the platform plate 17 and a right angle bracket 52 bolted on the spacer plate 40. The extensible member of the unit, the piston rod 54, on its outer end carries a yoke 55 between the parallel legs of which the pinion 33 is journaled by suitable bearing means on a short shaft 56 headed at the top and threaded at the bottom end for retention in the yoke by a nut thereon. The spacing of plates 39, 46 accommodates the lower side of the yoke.

The cylinder unit 34 is of the double-acting type so that the piston rod 54 and hence pinion 33 may be moved in opposite directions transverse of the truck by fluid pressure selectively supplied and exhausted at opposite ends of cylinder 50 through hydraulic hoses or lines 57, 58 leading to a control valve.

The hydraulic unit 34 is self-aligning in a horizontal plane, desirable in view of the diametric meshing of the pinion in the two racks and mobility of the one rack, as permitted by the mounting of cylinder 34 for pivotal adjustment about a vertical axis. Slight diametric clearance between the pivot bores and trunnions permits also any required slight aligning movement in a vertical plane.

From the nature of the mechanical movement involved in the differential rack-and-pinion system, it is obvious that the motion of the piston rod 54 is multiplied in a two-to-one ratio at the slide member 31. The useful length of the racks must of course be at least the length of the total piston excursion used. Accordingly, with the pinion 33 meshed at the centers of the racks when the member 31 is symmetrically or centrally disposed with

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respect to the platform, and the piston rod at half stroke or extension, the slide member 31 can be moved outward toward either side a distance equal to the full piston stroke available.

A hydraulic system to supply fluid to the cylinder must include a pressurized source of fluid such as a pump and means driving the pump; a reservoir from which fluid is drawn by the pump and to which it is returned from cylinder unit 24; and a fluid control valve for connecting the pump outlet selectively to one of the lines 57, 58 and connecting the other line to a fluid return line to the reservoir, or cutting off both pump and return line from the unit 34 to hold the mechanism at any given position; and usually a pressure control or relief valve in the pressured line from the pump. Various suitable hydraulic circuits or systems are known to the art and need no further description.

Conveniently, however, the pump, reservoir and control valve are located on the vehicle proper, with flexible hoses for lines 57, 58 running beneath the platform supported with suitable slack for the vertical excursions of the carriage. Where a separate electric motor driven pump is used for each such mechanism S the corresponding control valve may be linked with a power switch for the motor. In any event each mechanism advantageously is at least independently controlled by a separate valve to allow independent movement of the slide members 31 and thereby allow greater flexibility of operation. Such valve means, along with valves or switches for the motors 25 and elevator mechanism L may be conveniently located on the side of the vehicle at 60.

It will be noted that the elements of each mechanism S are compactly arranged immediately below the platform surface of the carriage in such manner that no fixed lateral projections beyond the platform are required to obtain the extended linear movement developed by the mechanism; and also that a minimum height of the platform at lowermost carriage position is attained without interference in relation to the wheels W on the vehicle frame F.

In Figs. 6 and 7, similar to Fig. 5 of the structure already described, the essential elements and relations of two modifications of the rack-and-pinion mechanism respectively appear, corresponding parts bearing corresponding reference numerals with letter subscripts however where specifically changed. Generally the arrangement of the member 31 and its slideway, and of the hydraulic piston and cylinder unit is the same in these modifications as in Figs. 1-5. However, there is used, in place of the simple pinion 33, a compound pinion element with an integral pair of gear formations or sets of teeth having pitch diameters say in two to one ratio.

In Fig. 6 the larger gear formation is meshed with movable rack 31c and the smaller with fixed rack 32a. Spacer bar 45a is rabbetted to clear the large gear formation, the under face of which bears on the fixed rack 32a and plate 39 to support the pinion element as a whole. The compound element 33a may be inverted in position, with the other structural elements supporting the fixed rack being modified in shape as required. With this arrangement, a three to one multiplication of the piston movement is attained in slide 31. The effective fixed rack length, as in the first case, is at least the length of the used piston stroke, but the movable rack formation 31c is at least twice as long in view of the fact that the peripheral motion of the pinion at the larger pitch circle is twice that of the smaller. Accordingly the racks and pinion are relatively positioned so that with the slide at "neutral" position, the pinion teeth mesh at the middles of the effective lengths of the respective racks.

In the modification of Fig. 7, again a compound pinion element 33b is used, but the gear formation having the larger pitch diameter meshes with the fixed rack 32b, and the smaller gear formation with the rack formation 31c on the slide 31. The mounting of the fixed rack is

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similar to that of Figs. 1-5. However, the slide supporting bottom plate is in the form of a heavier bar 39a rabbetted at 39b to accommodate the large diameter gear formation on pinion element 33b. Thus the bottom face of element 33b is supported at diametric regions by platform plate 46 and the horizontal shoulder of rabbet 39b; and vertical clearance may be provided between the bottom of slide 31 and the underlying portion of pinion element 33b. Here the slide to piston motion ratio is less than that in the form of Figs. 1-5—for example 1.5 where the pitch diameters of the gear formation of 33b are in two-to-one ratio. Analogous design considerations apply to the disposition of the effective rack lengths and pinion meshing at neutral position of the slide, as above discussed for Figs. 1-6 if equal excursions of a slide member to opposite sides of platform are desired; and if such is not desired, the disposition of the elements may be altered accordingly. In the compound pinions of Figs. 6 and 7, other pitch diameter ratios may be used than the two-to-one ratios stated by way of examples.

Operation

The vehicle is maneuvered into a position, and the carriage raised or lowered to any elevation within its operating range, required for receiving or unloading a die or other heavy load to or from a desired location.

A load then may be drawn onto the carriage platform endwise by engaging the same with cables means 29 extending from drums 26, and operating the winches as required to bring the load to desired position on the platform. With the winches independently controlled, the load may be to some degree turned as well as translated. The load may also be drawn off the carriage endwise by similar cable means, the direction of motion and force application of which is reversed by bending or carrying the same around the pulleys 27. In particular circumstances, other pulleys may be anchored to the environment apart from the truck for similar purpose.

For side loading of a die or the like onto the platform, the load may be engaged by chain or cable means secured to stanchions 21 and extending generally laterally from the carriage, and hydraulic units 34 are then actuated to move stanchions 21 in the proper direction to draw the load onto the platform.

Depending upon the load size and distance from the platform, each slide and the stanchion thereon may have various initial and subsequent positions. Thus where the truck platform is immediately adjacent the load situs, the slides would be at "neutral" position, and the stanchions located in apertures 31d selected as convenient for the cable or chain rigging. If the available movement of the slides is not sufficient to draw the load to desired position on the platform, then after the first movement of the slides, they are retracted, and the cable slack then taken up by moving the stanchions or shortening the rigging, for a second load advancement by the slides, the procedure being repeated as necessary.

When the truck cannot be maneuvered to bring the platform immediately adjacent the load situs, but the slides may serve even as useful partial bridges of the gap, the loading procedure, if necessary by stepwise load advancement, is generally that just detailed. In this case, when the load is situated in, or has come to, an overhanging position relative to supporting structures apart from the truck so that "bridge" support is required before further load movement, the slides are extended under the overhanging part of the load. Then the load is moved stepwise in the described manner toward the platform with intervening slide extensions progressively further under the load. The edges of the platform plates may be beveled or other means used if needed to guide the load from the slides to the platform surface.

In side unloading, the stanchions 21 are put into convenient holes 31d to form movable abutments which upon actuation of units 34 will bear upon the load to push the

same laterally from the platform, the slides being extended if necessary on the side of the truck opposite the discharge side, for example if a load spans the platform lateral dimension. Here again if an initial load moving advancement is not sufficient to clear the load from the platform, the slides 31 are retracted, the stanchions moved to other holes adjacent the load, and the load again advanced, with repetition of the process until the load is "inched" completely off the platform.

In some such side unloading situations, the projection of the slide members 31 toward a desired load situs, spaced laterally from the truck platform, at the latter part of the load shift may again provide a useful support at least partially bridging a gap between the platform and the desired load site, such as a press bed, where the truck cannot be brought immediately adjacent the bed.

In sideways load manipulations, again independent operation of the mechanisms S permits a turning as well as a translation of the load.

We claim:

1. An industrial truck including: a generally horizontal load supporting platform; mechanism for developing motion and forces directed transversely of the platform for side loading and unloading comprising a slide member mounted in a slideway beneath the platform surface for longitudinal movement transversely of the platform and having a longitudinal rack thereon, said platform having a slot adjacent and parallel to the slide member, a second rack member fixed beneath the platform in horizontally spaced parallel relation to the slide member, a double-acting hydraulic cylinder unit having a cylinder element secured at one end relative to the platform and a piston element acting parallel to and between the racks, pinion means meshed with said racks carried by the piston element, and stanchion means engaged with said slide member projecting through said slot above the platform surface to serve selectively as a load engaging abutment and as an anchor for load engaging means in moving a load relative to said platform; a second mechanism like the first and spaced therefrom lengthwise along the platform; and means supplying hydraulic fluid under pressure to said mechanisms for independent operation of the same.

2. In an industrial truck, the combination of the motion developing mechanism described in claim 1, with means adapted to develop force and motion lengthwise of the platform for loading and unloading endwise of the platform.

3. An industrial truck as described in claim 1, wherein said platform is vertically movable to selected positions.

4. An industrial truck as described in claim 1, wherein said slide members are adapted to be extended laterally beyond the platform surface to serve as load supporting outriggers.

5. An industrial truck as described in claim 1, wherein said pinion means comprises a simple gear element meshed at diametrically opposite regions with respective racks.

6. An industrial truck including: a generally horizontal load supporting platform; mechanism for developing motion and forces directed transversely of the platform for side loading and unloading comprising a slide member mounted in a slideway beneath the platform surface for

longitudinal movement transversely of the platform and having a longitudinal rack thereon, said platform having a slot adjacent and parallel to the slide member, a second rack member fixed beneath the platform in parallel relation to the slide member, and horizontally spaced therefrom with a vertical offset; a double-acting hydraulic cylinder unit having a cylinder element secured at one end relative to the platform and a piston element acting parallel to and between the racks, compound pinion means having gear formations of different pitch diameters each meshed with a respective said rack and carried by the piston element, and stanchion means engaged with said slide member projecting through said slot above the platform surface to serve selectively as a load engaging abutment and as an anchor for load engaging means in moving a load relative to said platform; a second mechanism like the first and spaced lengthwise along the platform; and means supplying hydraulic fluid under pressure to said mechanisms for independent operation of the same.

7. An industrial truck as described in claim 6, with each said compound pinion means having a gear formation of larger pitch diameter meshed with the rack of said slide member and a gear formation of smaller pitch diameter meshed with said fixed rack.

8. An industrial truck as described in claim 6 with each said compound pinion means having a gear formation of larger pitch diameter meshed with said fixed rack and a gear formation of smaller pitch diameter meshed with the rack of said slide member.

9. An industrial truck including: a generally horizontal load supporting platform; mechanism for developing motion and forces directed for moving a load horizontally over an edge of the platform comprising a slide member mounted in a slideway beneath the platform surface for longitudinal movement parallel to the platform and having a longitudinal rack thereon, said platform having a slot adjacent and parallel to the slide member, a second rack member fixed beneath the platform in horizontally spaced parallel relation to the slide member, a double-acting hydraulic cylinder unit having a cylinder element secured at one end relative to the platform and a piston element acting parallel to and between the racks, pinion means meshed with said racks carried by the piston element, and stanchion means engaged with said slide member projecting through said slot above the platform surface to serve selectively as a load engaging abutment and as an anchor for load engaging means in moving a load relative to said platform; a second mechanism like the first and spaced parallel thereto along the platform; and means supplying hydraulic fluid under pressure to said mechanism for independent operation of the same.

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