July 31, 1956 J. A. ACKERMANN 2,756,885

DIE HANDLING INDUSTRIAL LIFT TRUCK

Filed June 11, 1954 3 Sheets-Sheet 1

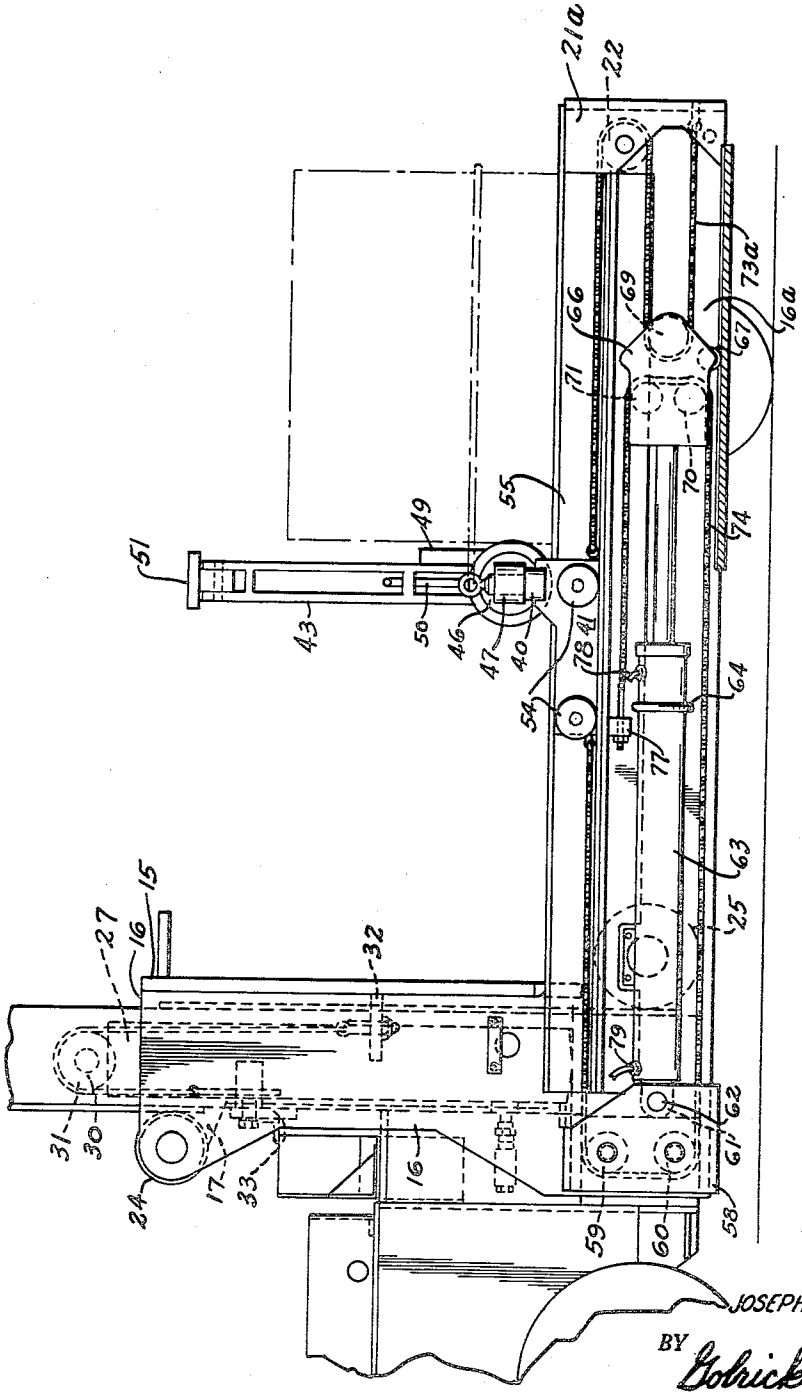


Fig. 1

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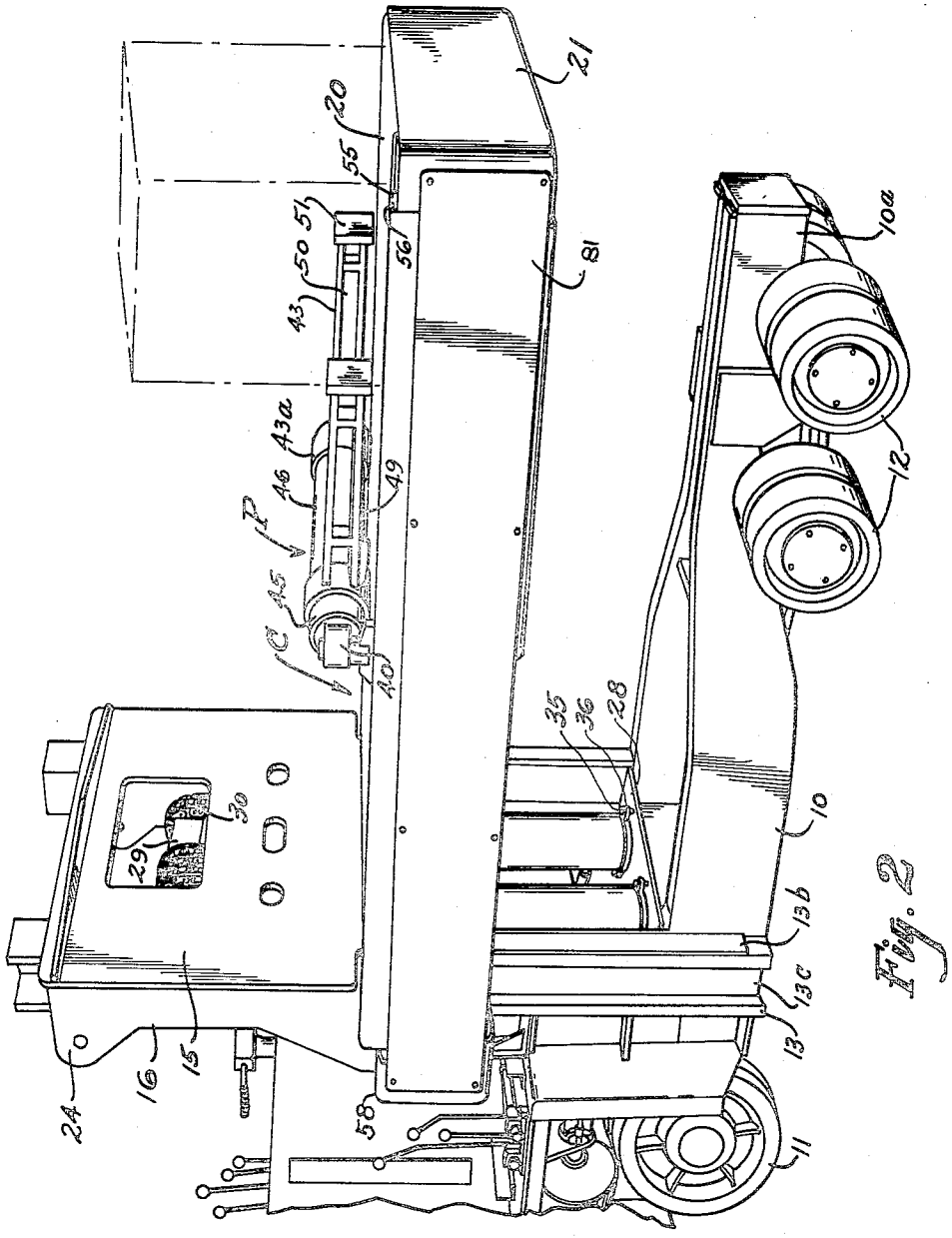


Fig. 2

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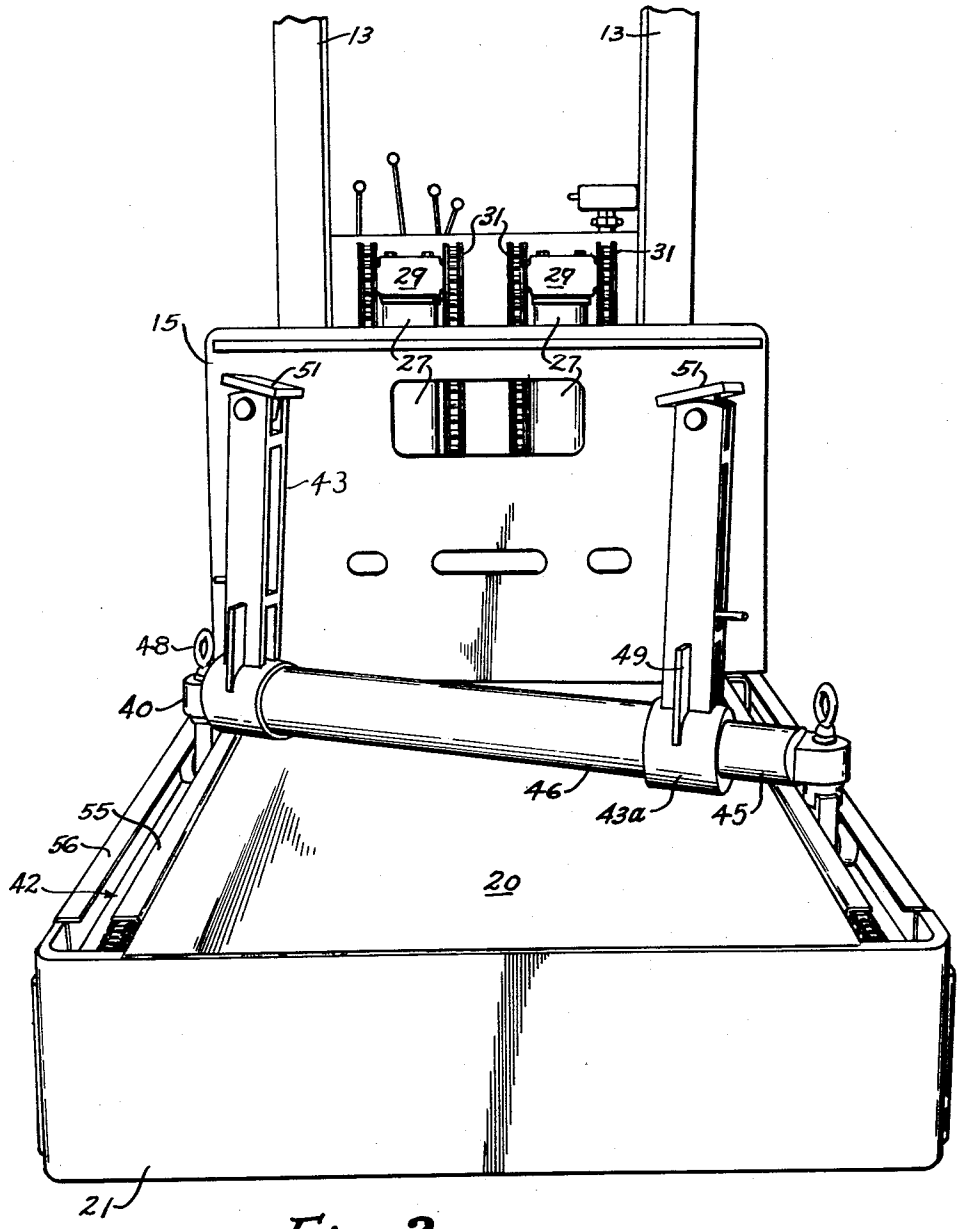


Fig. 3

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DIE HANDLING INDUSTRIAL LIFT TRUCK

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5 Claims. (Cl. 214—514)

This invention relates to improvements in means associated with an industrial truck for the manipulation and handling of concentrated relatively heavy loads such as sheet metal forming dies used in large presses for the forming of automotive body parts.

In current manufacturing methods wherein large presses are used in forging and sheet metal forming operations, frequent changing of the dies is often desirable and the time consumed in the change is an important cost factor since the heavy investment in such presses requires that they be maintained in production operations. The dies used in such presses frequently weigh several tons and heretofore the use of industrial trucks equipped with die tackling means have been proposed for removing, storing and replacing the dies. Space restrictions on truck maneuvering about the press has been a hindering factor heretofore and the general object of the present invention is the provision of means on a heavy-duty industrial truck which can be presented to the die load and engage it to effect extraction of the die equipment from the press in an expeditious manner and which will also serve to position the die equipment in the press when changes are desired.

To this end a heavy duty tier lift truck of the platform type is provided with a dual hydraulically operated load engaging means which is effective in manipulating a die set on the bed of the press during die set up operations and which will be effective in removing and replacing die sets in presses of the aforementioned type.

A more specific object is the provision of a die handling means on an industrial truck which will be of sufficient ruggedness as to handle safely die sets of relatively heavy weight and store the same.

A more specific object of the present invention is the provision of a multiple force applying mechanism on the platform structure of a tier lift truck which will serve to apply pushing and pulling forces to the load simultaneously or selectively thereby to maneuver the load as desired.

Other objects of the invention hereinafter will become apparent to those skilled in the art from the following description referring to the accompanying drawings which illustrate a preferred form thereof. The essential characteristics of the invention are summarized in the appended claims.

In the drawings:

Fig. 1 is a partial side view showing the pertinent parts of a truck embodying this invention, certain parts being removed or broken away to show the structure more clearly;

Fig. 2 is a perspective side view of the truck with the elevator carriage in a raised position and the die manipulating mechanism in position for use of the pusher arms; and

Fig. 3 is a view in perspective from a point above and in front of the truck.

The truck of this invention as shown in the drawings is comprised of a dirigible automotive vehicle chassis V, a hydraulically operated elevator mechanism E including a vertically movable elevator carriage C with a horizontal bed or platform for transporting dies, a die manipulating device P for engaging a die to be drawn onto or pushed off the platform, and along each side of the platform a double acting hydraulically operated motion multiplying mechanism H for moving the opposite sides of P independently.

Two longitudinal beam members **10**, converging to a narrow front portion **10***a* and joined by suitable cross members provide a vehicle frame supported at the rear by the driving wheels **11** and at the front along the narrowed portion **10***a* by two pairs of double wheels **12** mounted together in such fashion as to form a power steering assembly with the wheels adapted to accommodate to unevenness of the truck supporting surface. The steering assembly is not here described in detail since per se no part of this invention. A pair of parallel heavy upright column members **13** are welded to the outside of the long frame members **10** to provide the uprights of the elevator mechanism supporting the carriage C in vertically removable relation. At the rear of the vehicle above and overhanging the driving wheels suitable structure is provided on the frame for support of the truck driving and operating mechanism, such as batteries, motors and controls for an electric truck, an operator's station, not further detailed since standard vehicle structure and equipment, and certain controls and various hydraulic pump equipment hereinafter described.

In the carriage, a transverse vertical plate **15** serves as a base to the rear face of which are welded two like pairs of spaced plates **16** and **17**, outer and inner plates respectively, extending vertically and rearwardly along opposite sides of each upright column **13**, while if desired, a reinforcing gusset **18** may be welded at an angle between the outer plate **16** and the base plate. To form a die supporting platform, a horizontal bed plate **20** is welded at its back edge to the transverse base plate **15** and along lateral edges to the top edges of forward extensions **16***a* of the lower part of the plates **16** which form side skirts of the platform, while a fore skirt plate **21** welded to the forward edges of the horizontal and skirt plates has each end portion reflected rearwardly in outwardly spaced relation to the side skirts **16***a* to form a housing and bracket support **21***a* for sprocket **22**. The carriage is movably supported on the uprights by roller wheels **24**, journalled on short shafts between the plates **16** and **17** near the top of the carriage to roll on the back face of the uprights **13**, and by lower wheels **25** rolling on the forward face of uprights, each journalled on a corresponding shaft between the side skirts **16***a* and a bracket plate depending from the bottom of the bed plate **20**. Those portions of the uprights traversed by the carriage wheels may be provided with hardened bearing strips **13***a*, **13***b*. If desired, auxiliary guide means in the form of rollers or perhaps simple studs may be provided projecting from the outer plate **16** inwardly within the lateral shallow channels **13***c* of the columns to engage one of the channel surfaces.

A pair of single-acting hydraulic piston and cylinder elevator lift units **27** between the elevator uprights **13**, with lower convex cylinder ends bearing upon the horizontal member **28** of the frame to take the thrust of lifting forces, are each provided with a double sprocket piston crosshead **29**, over each of the sprockets **30** of which there is reaved a corresponding chain **31** anchored at one end to the cross member **32** on the back of the carriage base plate **15** and at the other end to a member **33**, secured across the back faces of the upright columns below the limit of travel of the upper wheels **24**. At the lower end of each cylinder, bolts **35** are passed through diametrically disposed cylinder lugs **36** and threaded into the horizontal frame member **28** to maintain the lateral

spacing of the cylinders without however absorbing any of the lifting forces. With the reaving system here provided a two to one motion ratio is provided between the movement of the carriage and that of the pistons.

To power the hydraulic lifting cylinder units, there is located on the truck frame a hydraulic oil reservoir, a motor driven pump delivering oil from the reservoir to the cylinders, and suitable control elements controlling the pump motor operation and flow of fluid from the pump to the cylinders in elevator lifting and from the cylinders back to the reservoir in lowering the elevator. However, for purposes hereinafter described, it is preferable that two pumps driven by a common motor be provided with a lift cylinder control including an oil valve which puts the pump outlets in parallel relation to provide a single common source of hydraulic fluid to both cylinders in elevator lifting and for directing the fluid to the reservoir for lowering the same. A common manual control lever is mechanically interlinked with both a motor control switch for the electric pump motor and lift cylinder oil valve means in such manner that with the control lever at "lift" position, the pump motor is on and the oil valve connects the pumps in parallel relation to supply oil to the cylinders; at "hold" position, the motor is off and flow of hydraulic fluid relative to the cylinders blocked; and at "lowering" position the motor is off with the hydraulic line to the lift cylinders opened to the fluid reservoir to exhaust fluid from the cylinders and permit the carriage to descend by gravity.

The die manipulating mechanism P comprises a pair of stanchions **40** on carriages **41** independently moveable in track assemblies **42** along each side of the bed or platform, cable anchor elements on the stanchions and a pair of die pusher arms **43** carried by an extensible support in the form of telescoping cylinder members **45**, **46** with opposite end lugs **47** pivoting on the upper parts of the stanchions. The anchor elements may be removeable eye pins **48** dropped into bores of the stanchions. Each arm **43** is mounted on the outer cylinder **46** by a sleeve portion **43***a* permitting the arms to be swung to an upright position from their normal forwarding extending horizontal disposition, used in pushing a die or other load from the bed. A rib **49** running partway out from the sleeve along the arm, in coming to bear on the surface of bed **20** serves as a stop maintaining the arm in horizontal position, while a lock pin **50**, slideably mounted on the arm and spring biased inwardly to project radially through the sleeve for detent engagement with apertures in the outer cylinder **46**, holds the arm in selected position. Load contact pads **51** pivotably secured on the free ends of the arms are self-adjusting to the disposition of the load surface against which the arms bear.

The hydraulically powered mechanisms H provided for each stanchion afford means for moving the opposite ends of the manipulating device P independently. In each mechanism H, the carriage **41** is on each side supported by a pair of roller wheels **54** running in tracks formed between the flanges of opposed inner and outer channel members **55**, **56**, extending along the top portion of the corresponding side skirt **16***a* of the carriage platform and spaced to provide a slot between the upper channel flanges through which the carriage stanchion **40** extends. The channels are secured to the skirt **16***a*, the inner channel **55** directly and the outer channel **56** through an angle member as a bracket with one side underlying both channels.

The channels extend from the housing **21***a* of the fixed forward sprocket **22** back beneath the outer edge of plate **15** toward a bracket plate **58**, spaced outwardly from the lower back area of side plate **16** by side flanges welded thereto to form a housing for sprockets **59**, **60** journalled on vertically spaced shafts between bracket **58** and carriage side plate **16**.

A double acting hydraulic piston and cylinder unit, mounted with the cylinder anchor lug **61** held by a pin **62** between plate **16** and bracket **58** and with the working end of the cylinder **63** held to side skirt **16***a* by a U-shaped clamp bolt **64**, includes a piston crosshead **66** on the piston rod supported in its working stroke by a roller **67** running on a flange or plate **68**, along the bottom of the side skirt. Between the two spaced vertical plates forming the piston crosshead are mounted the support roller **67**, the end of the piston rod, the single sprocket roller **69** near the forward end of the crosshead and in line with the piston axis, and the pair of sprocket rollers **70**, **71** spaced on either side of the piston axis inward of the support roller. The chain **73** with one end anchored at the front of the carriage **41** and passing around the forward fixed sprocket **22** and the forward sprocket **69** of the crosshead with its other end anchored to the fore skirt; and the chain **74** with one end anchored to the back of the carriage **41** and passing around the fixed rear sprockets **59**, **60** and the rear sprockets **70**, **71** of the crosshead with the other end anchored to the anchor bracket **77** on the side skirt, constitute two to one motion multiplying connections by which the forces of the unit are applied to the carriage **41** for pushing a load from or drawing it upon the bed. Hydraulic fluid under pressure is of course supplied to forward cylinder port **78** to drive the crosshead **66** back in advancing the device and thereby expelling fluid from rear port **79**; and to the rear port **79** in retracting P.

Preferably individual hydraulic pumps supply hydraulic fluid pressure through individual oil reversing control valves to the cylinder units, the two controlled outlet ports of each valve being connected to lines **78** and **79** of a corresponding cylinder, so that the two carriages may be moved independently, or may apply different forces to a load, whereby more flexible load manipulation may be had without shifting the vehicle. An independent hydraulic pressure system may be used for the pusher actuating cylinders; but to the same end, the previously described hydraulic power system of the elevator, namely the motor, two pumps and reservoir may be used with suitable cooperating controls, since there is little or no need simultaneously to lift and horizontally shift a load. The two pumps of the lift system driven by the single motor act in tandem in supplying the double acting cylinder units, each supplying oil to one of the units through a control valve adapted to direct oil selectively to either end port of the unit, while releasing oil from the other port to the reservoir, or to block oil flow altogether for locking a carriage at particular position.

For such control system, each unit would require an oil reversing valve with a valve inlet connected to the outlet of one of the pumps, an exhaust port connected to the oil reservoir, and two controlled ports connected to the opposite ends of the cylinder, so that by movement of a valve piston member from neutral position (where oil to and from the cylinder through the valve is blocked locking the cylinder), to one or the other of two operating positions, oil is directed to one or the other end of the cylinder, while the other end is exhausted to the reservoir. Manual control means for each of these valves is mechanically or otherwise linked to a control switch for the electric pump motor, so that when either of the controls is moved to a cylinder operating position, the pump motor is turned on. To use these same two pumps acting in parallel to supply oil to a common line branching to the two lift cylinders **27**, additional lift control valves may be inserted in the lines between a pump and corresponding reversing valve. Each of these lift control valves has a controlled outlet port connected to the common feed line to the lift cylinders, an exhaust outlet for returning the oil from the lift cylinders to the reservoir, an oil inlet connected to the corresponding pump, and a valve piston element which at neutral position blocks flow relative to the cylinders, at elevator lowering position connects the cylinder ports to the valve exhaust port, and

at lift position directs fluid from the pump inlet ports through the valve outlet ports to the common feed line. A single manual control element for the lift cylinders is mechanically linked to such lift control valves and to a switch for the pump motor to connect the pumps in parallel when the motor is turned on for elevator lifting by shifting the valve elements to direct fluid to the common cylinder feed line.

The operation of this truck will be described in terms of heavy dies inserted or removed from the die bed of a press with transportation to or from a die storage area.

The truck is maneuvered into suitable position adjacent endwise to a die to be removed from a press bed or storage location, and the carriage is raised if necessary to the level of the die. The manipulating device P with arms upright is run forward to the end of the platform and the die is secured thereto by steel cable or the like secured to the anchor elements of the stanchions and to anchor formations on the die, or simply passed around the die. The manipulating device is then retracted drawing the load onto the bed or platform of the carriage, the two stanchions being moved, if required for the desired disposition of the die on the carriage, with a differential movement through the independent controls of their hydraulic power mechanisms. In Fig. 1 the truck is shown in the process of drawing a die D onto the carriage through cables L secured to the anchor eyes of the stanchions.

After the truck is run, with carriage lowered, to the point for unloading, say a press bed, the truck is directed into a position whence the die may be pushed off endwise of the carriage into the press bed, the carriage height being adjusted as required. The manipulating device P is advanced to push the load from the platform into the press bed. Where the additional reach of the pusher arms beyond the end of the carriage is not needed, this may be done with the arms in upright position. If the projecting length of the arms is needed and the carriage platform area occupied by the die permits the arms to be dropped, the arms may be used for the whole push-off strike; otherwise, after an initial advancement of the die on the platform to give clearance for dropping the arms to horizontal position, the device P is retracted, the pusher arms released and dropped into horizontal position, and the device P again advanced to move the die through the arms. Since the manipulating device is thus in contact with the die after the die is off the carriage bed, the die may be squared away or moved within certain limits to some particular orientation in the press by the differential movement afforded by the independent control of the two carriages. Of course in such loading and unloading operations, the frictional forces developed between the load and a surface external to the truck may require that the truck brakes be applied to keep the vehicle from shifting.

I claim:

1. In an industrial truck of the lifting platform type, a movable stanchion disposed at each side of the platform structure of the truck to extend from below to above the load supporting surface of the truck, stanchion carrier means disposed below the platform load supporting surface for supporting each stanchion, a guiding trackway structure for each carrier means, hydraulically operated means disposed parallel to each trackway, motion multiplying means connecting the hydraulically operated means to the stanchion carrier means, load engaging means connected to the stanchions, a source of hydraulic power on the truck and controller means for selectively connecting the hydraulically operated means and the source of hydraulic power whereby the stanchion carriers may be selectively moved.

2. In an industrial truck of the lifting platform type, a moveable stanchion disposed at each side of the platform structure of the truck to extend from below to above the load supporting surface of the truck, stanchion carrier means disposed below the platform load supporting surface for supporting each stanchion, a load engaging telescopic means connecting the stanchions, a guiding trackway structure for each carrier means, a hydraulic ram disposed parallel to each trackway, a crosshead for each ram, a trackway for the crosshead and motion multiplying means connecting the hydraulic means to the stanchion carrier means.

3. An industrial truck of the lifting platform type having a load moving stanchion disposed to operate at each side of the truck platform to push or pull a load from or to the load supporting surface of the platform in a direction longitudinally of the truck, load engaging means yieldingly connecting the two stanchions, stanchion carrier means for each stanchion mounted on trackways on the platform disposed below the load supporting surface of the platform, a double acting hydraulic ram for operating each carrier means including a motion multiplying means connecting each ram to its carrier and load pushing arms pivotally connected to the stanchion connecting means.

4. An industrial truck of the lifting platform type having a load moving stanchion disposed to operate at each side of the truck platform to push or pull a load from or to the load supporting surface of the platform in a direction longitudinally of the truck, yieldable means connecting the stanchions above the platform, stanchion carrier means for each stanchion mounted on trackways on the platform structure disposed below the load supporting surface of the platform, and a power means for operating each carrier means.

5. In an industrial truck of the lifting platform type, a load moving stanchion disposed to operate at each side of the truck platform to push or pull a load from or to the load supporting surface of the platform in a direction longitudinally of the truck, stanchion carrier means for each stanchion mounted on trackways on the platform disposed below the load supporting surface of the platform, load engaging means on the stanchions, a double acting hydraulic ram for operating each stanchion carrier means including a motion multiplying means connecting each ram to its stanchion carrier means, a source of hydraulic power on the truck, hydraulic lines extending from the power source to said hydraulic rams and controller means for selectively connecting the lines to said rams.

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