Oct. 14, 1952 R. M. STANLEY 2,613,822

WEAPON HANDLING UNIT

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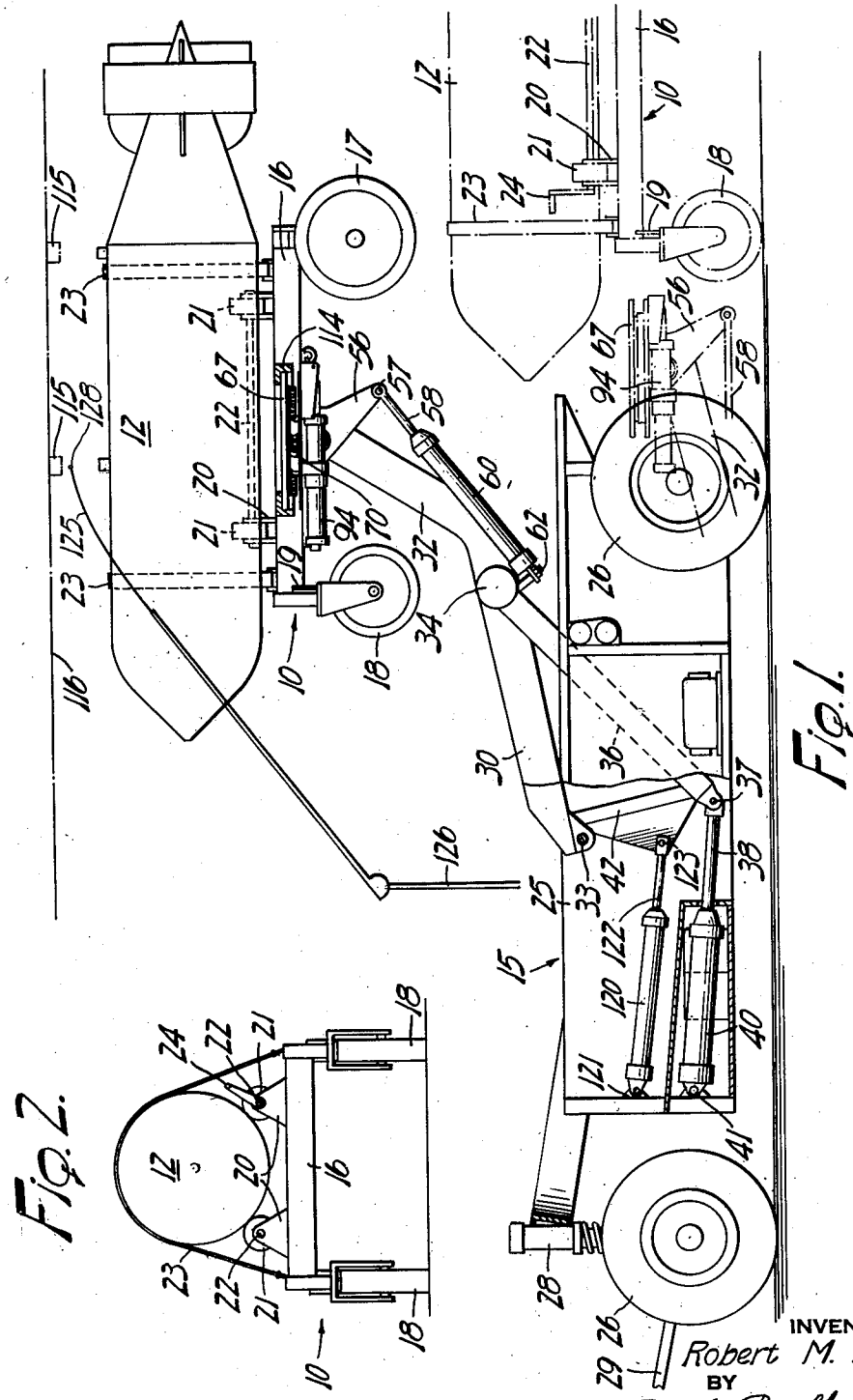

Fig. 1.

Fig. 2.

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Fig. 3.

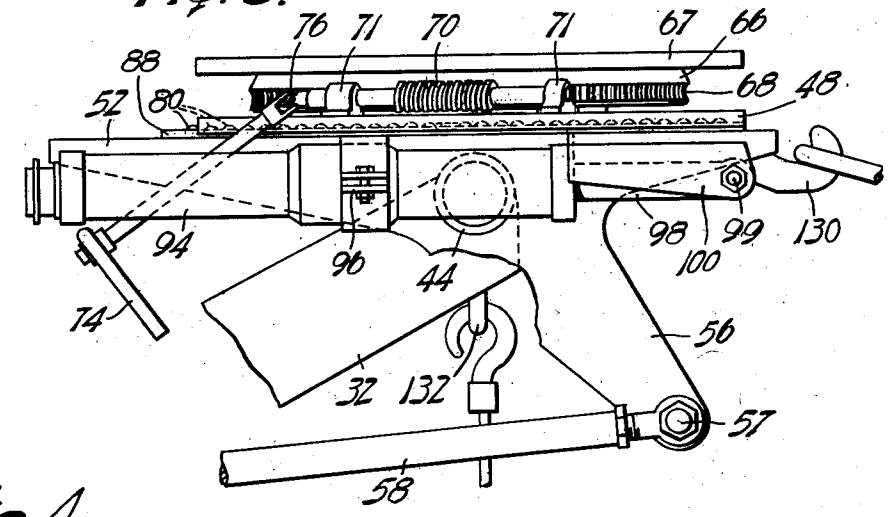

Fig. 4.

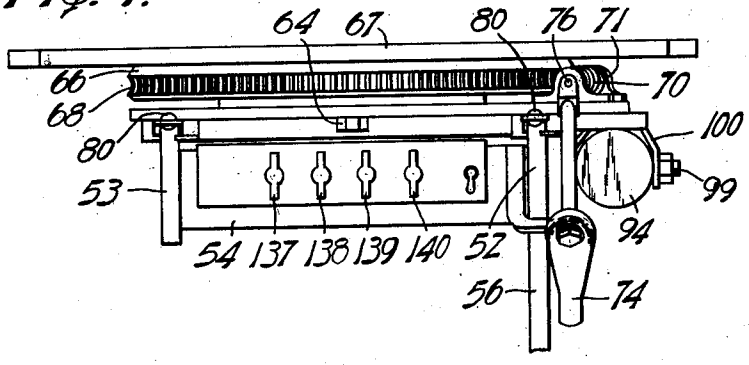

Fig. 7.

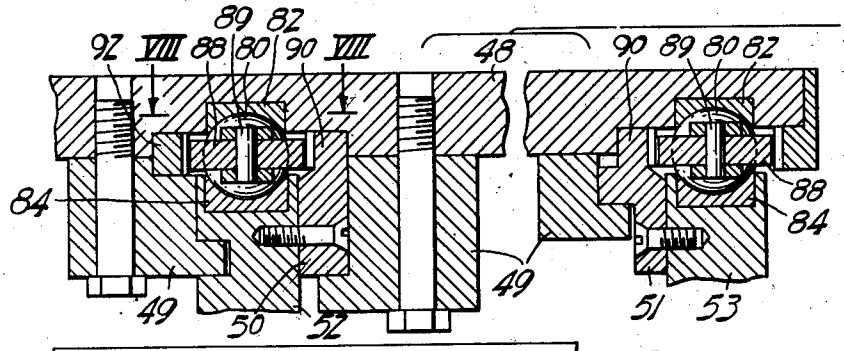

Fig. 8.

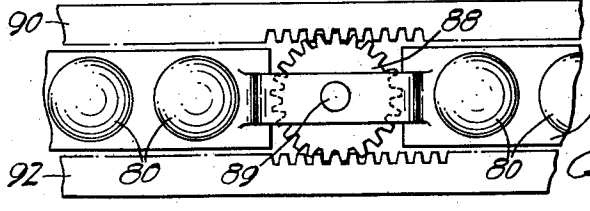

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Fig. 5.

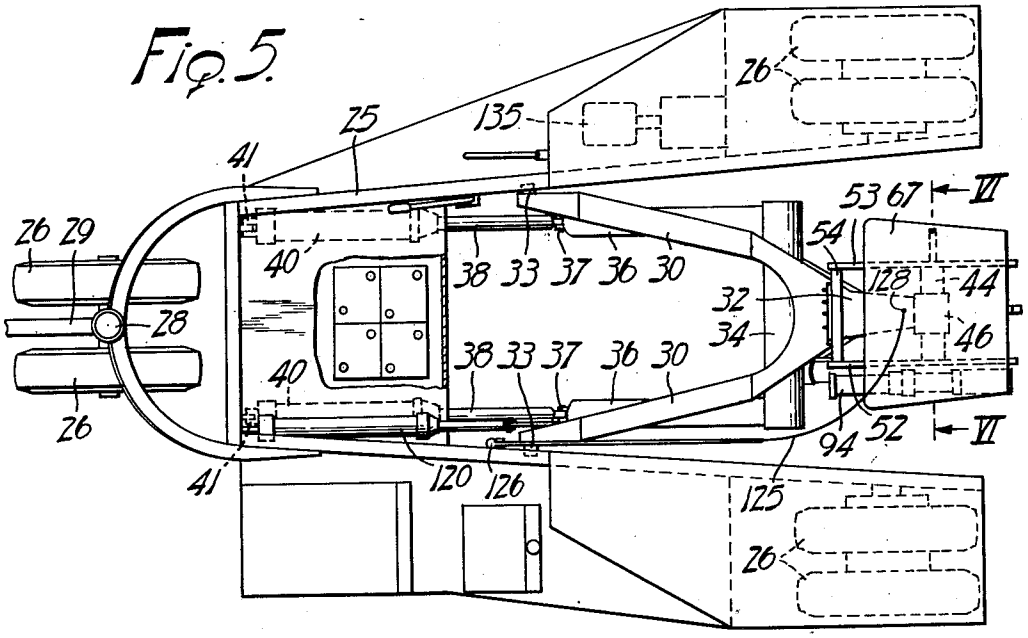

Fig. 6.

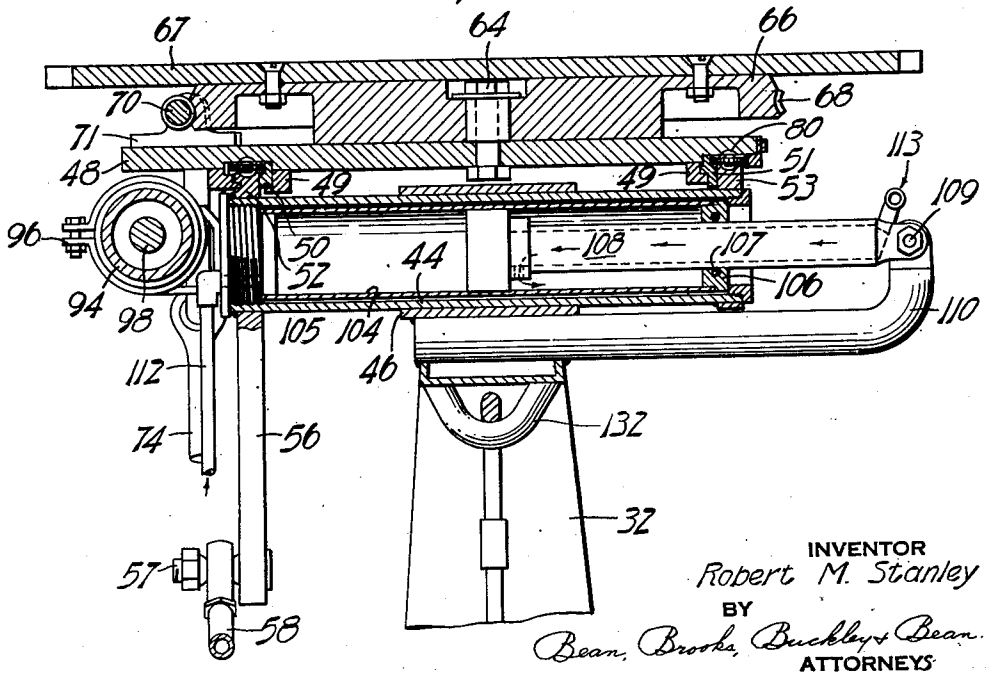

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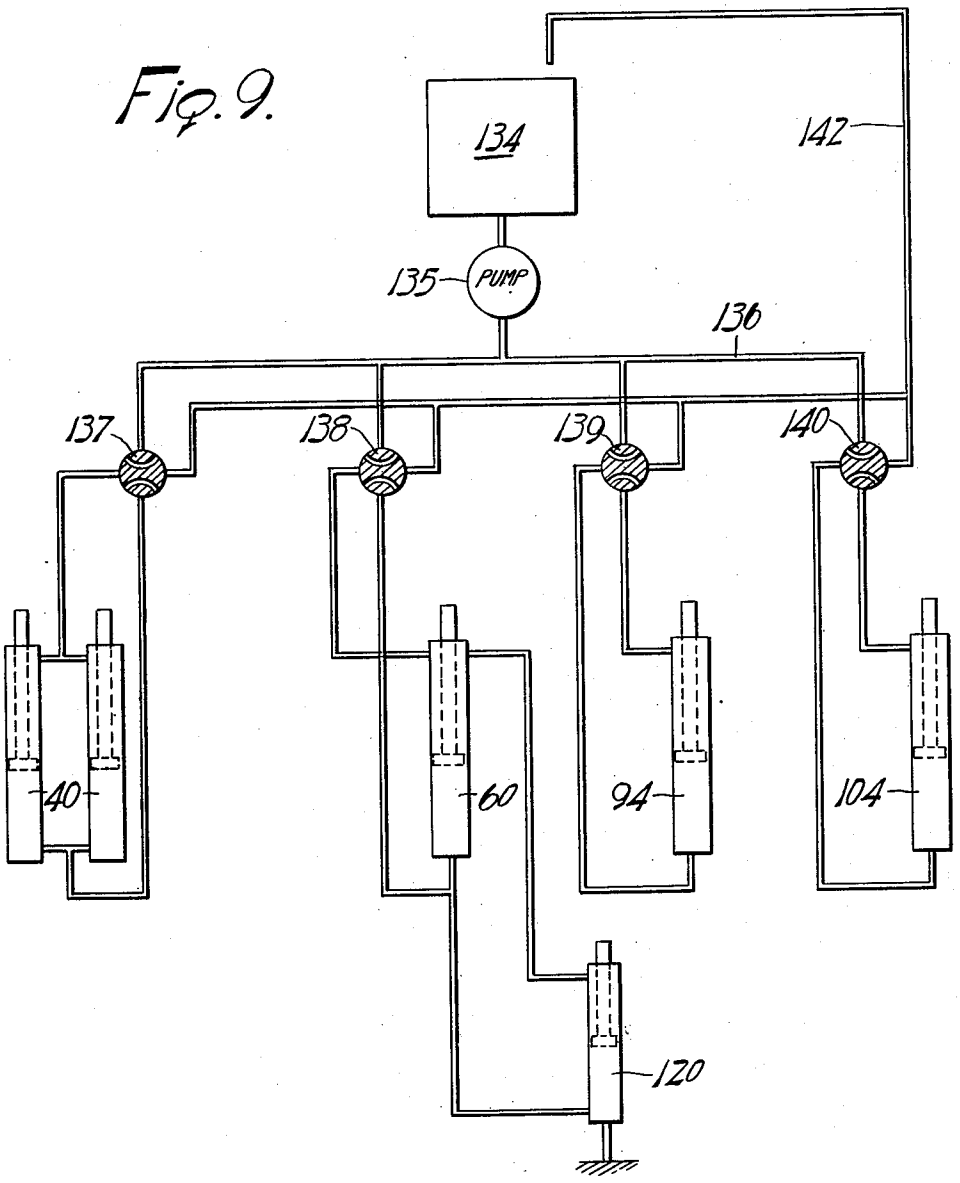
Fig. 9.



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Patented Oct. 14, 1952 2,613,822

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2,613,822

WEAPONS HANDLING UNIT

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Application December 8, 1949, Serial No. 131,727

4 Claims. (Cl. 214—1)

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This invention relates to weapons handling equipment, and more particularly to equipment for transporting bombs, torpedoes, guided-missiles, and the like from stock piles or other ground stations and to elevate such weapons into connection with bomber aircraft bomb bay or wing shackle devices.

It is one of the objects of the invention to provide an improved device for picking up a bomb or missile or the like for transporting it to a bomber or missile carrying aircraft, and then elevating it into connection with the shackle devices of the aircraft.

Another object of the invention is to provide a device as aforesaid, which includes novel arrangements whereby as the load is eelvated for connection to the aircraft carrying shackles, the load may be positionally maneuvered relative to the load receiving shackle devices with utmost facility and in improved manner.

Another object of the invention is to provide in a device of the character described an improved load suspension arrangement whereby the load is supported in improved manner during transport.

Another object of the invention is to provide in a mechanism of the character described improved means for positionally maneuvering the bomb or missile as it is elevated into shackle connecting position.

It is another object of the invention to provide a device which is in addition to the aforesaid adapted to assist in pre-flight check-outs of guided missiles and the like.

Other objects and advantages of the invention will appear from the specification hereinafter.

In the drawing:

Fig. 1 is a side elevational view partly in section of a device of the invention, showing by means of broken and solid line illustrations relative positions of a load member of the bomb type during different phases of its handling operation;

Fig. 2 is an end elevation of the load supporting truck portion of the equipment;

Fig. 3 is a fragmentary side elevation, on an enlarged scale, of a portion of the load handling and positionally maneuvering mechanism of the invention;

Fig. 4 is a front elevational view of the mechanism of Fig. 3;

Fig. 5 is a top plan view, partly in section, of the load lifting and handling mechanism of the invention;

Fig. 6 is a vertical section, taken along line VI—VI of Fig. 5;

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Fig. 7 is a fragmentary vertical section in the plane of Fig. 6, but showing details of the construction in larger scale;

Fig. 8 is a fragmentary section taken along line VIII—VIII of Fig. 7; and

Fig. 9 is a diagrammatic illustration of the hydraulic control system of the mechanism.

The invention contemplates an improved means for picking up, handling, elevating and loading weapons of the type referred to hereinabove into connection with bomb bay or wing shackle devices of carrying aircraft; and also for handling such weapons during pre-flight checking procedures. For example, with a missile hoisted in the air by the device of the invention prior to its delivery to the carrying aircraft, the missile propulsion system can be checked at various attitudes of pitch and roll, and at moderate rates of pitching and rolling by appropriate manipulation of the equipment of the invention. Also, the gyros of the missile may be thus exercised and the missile servo mechanism response measured as the missile is given motions corresponding to pitching, rolling and yawing motions while in flight. Also, in event the missile includes a seeker device this may be checked in connection with the servo mechanisms and the gyros, to determine the overall functioning of the missile prior to its expenditure. Also, by suspending the missile from a sling attached to the lifting boom of the device, the center of gravity of the missile may be readily determined.

As illustrated in Figs. 1 and 2, the invention is illustrated to include two separate units comprising a truck designated generally at 10 for direct mounting thereon of a missile, torpedo, or bomb such as is designated 12; and a handling unit generally designated 15 which incorporates a boom device and operative mechanism therefor whereby the boom device is projectable into engagement with the load truck for bodily lifting the truck and its load and transporting and elevating the load as into the bomb bay of an aircraft or into connection with wing shackle devices while maneuvering the load piece into accurate alignment with the mounting shackles, as will be explained hereinafter.

The load carrying truck device 10 is illustrated to comprise a rectangular frame 16 mounted upon directionally fixed wheels 17 and castering wheels 18; there being provided a castering motion locking pin device 19 for locking each of the wheels against castering, whenever required. The frame structure 16 mounts bearing blocks 20 upon which are carried rollers 21 which there-

by provide a cradle upon which the cylindrically shaped bomb or other weapon may rest. A torque rod 22 is provided to interconnect two of the rollers. Strap devices as indicated at 23 are arranged at opposite ends of the truck so as to be extensible over the load for strapping the latter down into the cradle provided by the rollers 21, while at the same time permitting the loaded member to be rotated relative to the truck frame upon the rollers 21 provided the straps are slightly loosened. The rod 22 is provided with a crank handle 24 whereby one pair of the rollers 21 may be rotated manually to cause the loaded member to rotate in the cradle structure, for purposes as will be explained more fully hereinafter.

The handling unit 15 is illustrated to include a truck body or frame 25 supported upon ground wheels 26 (Figs. 1 and 5) at the front and rear end portions of the frame so as to suspend it in "low-hung" relation from a three-point wheel arrangement. Hence, the unit is adapted to be moved into position under the open bomb bay doors of an aircraft or the like, or under the wing of a bomber airplane, without interference with the aircraft structure. The front wheels of the carriage 25 are close-coupled upon a central swivel post 28, and a tongue 29 extends from the front axle for connection to any suitable tractor or the like for pulling the carriage between loading and unloading stations.

The frame 25 mounts therein a wishbone shaped boom device having spaced leg portions 30 extending in divergent relation from the boom apex portion 32 and terminating in pivotal connections as indicated at 33 with opposite side wall portions of the carriage frame 25. The boom structure also includes an integral cross head 34 having struts 36 extending therefrom in parallel relation from the opposite ends thereof. The struts 36 extend forwardly and downwardly from the crosshead 34 and divergently from the boom legs in side elevation, and pivotally interconnect at their lower ends as indicated at 37 with piston rod elements 38 of corresponding hydraulic cylinders 40 which are fixed as indicated at 41 to the vehicle frame. Stiff arms 42 (Fig. 1) interconnect the lower ends of the legs 30 and the struts 36 thereby completing a truss structure which is pivotable about the aligned axes of the pivot pins 33—33 in response to actuation of the cylinders 40—40.

At its upper end the boom portion 32 carries a transverse bearing sleeve 44 (Figs. 3, 5, 6) so that the sleeve 44 is both rotatable and axially slidable relative to the boom member 32; the sleeve 44 being mounted in slip-fitting relation within a circular eye portion 46 of the upper end of the boom member. A load carrying platform is mounted upon the transverse sleeve 44 and as illustrated in Fig. 6 includes a base plate 48 formed with parallel slideways 49—49 which engage under flange portions 50, 51 of a pair of side rail members 52, 53 (Fig. 7). The side rails 52, 53 are bored and slip-fitted upon the opposite ends of the transverse sleeve 44 and suitably fixed thereto so as to provide therewith a platform frame terminating at the front end thereof in a transverse spacer bar 54 (Fig. 5). The side rail 52 is formed with a downwardly extending crank arm 56 which terminates in a pivotal connection 57 with the piston rod element 58 of a hydraulic cylinder 60 (Fig. 1). The cylinder 60 is fixed at one end by means of a bracket 62 to the boom structure. Thus, it will be appreciated that upon displacement of fluid within the cylinder 60, as will be explained hereinafter, the device will operate to cause corresponding tilting of the boom platform plate 48 relative to the boom per se.

The platform plate 48 mounts centrally thereof a king pin 64 (Fig. 6) which engages a circular plate 66 to be rotatable upon the base plate 48. The circular plate 66 mounts a platform plate 67 for engagement with the under surface of the load carrying truck 10 as will be more fully explained hereinafter. The circular plate 66 of the platform construction is peripherally toothed as indicated at 68 (Figs. 3, 4, 6) and a worm gear 70 is mounted by means of bearing blocks 71 upon the base plate 48 so as to mesh with the gear portion 68 of the circular plate 66. A hand crank 74 is connected to the worm gear shaft 70 by means of a universal joint 76 (Fig. 3) whereby it will be understood that manual manipulation of the crank 74 will cause the platform top plate 67 to be rotated about the axis of the king pin 64.

As shown in Figs. 6, 7, 8, the platform base plate member 48 is mounted upon the side rails 52—53 for movement thereon in directions longitudinally of the carriage by means of anti-friction bearing devices comprising hardened steel balls 80 arranged to roll in upper and lower track members 82—84 retained within the base plate 48 and the side rail members, respectively. The balls 80 are maintained in spaced relation by means of retainer plates 86 each of which carries centrally thereof a gear wheel 88 (Figs. 7–8) mounted upon the retainer plate by means of a pin 89 and meshing at its opposite sides with gear racks 90—92 carried by the side rails and the base plate 48, respectively. Thus, as the base plate 48 moves relative to the side rails 52—53 in directions longitudinally of the unit frame, the spur gears 88—88 are thereby caused to rotate in such manner that their axles are positionally displaced in the direction of platform movement, but only at one-half the rate of movement of the platform. Hence, the ball retainers are kept in proper position between the side rails and the base plate 48 during the limited range of movement of the platform under normal operating conditions; but this construction permits the platform to be disassembled from the side rails for servicing purposes by simply continuing the platform movement until the structure comes apart.

To control the platform movement relative to the side rails 52—53 for normal operation of the device as will be explained more fully hereinafter, a hydraulic jack device is employed, and comprises as illustration in Figs. 1, 3, 4, 5, a cylinder 94 which is fixed to the side rail 52 by means of a bracket 96; the piston rod member 98 of the unit being connected at 99 (Fig. 3) to a bracket 100 extending from one side of the platform base plate 48. Thus, it will be appreciated that displacement of fluid within the cylinder 94 will cause the platform to reciprocate relative to the upper end of the boom member 32, in directions longitudinally of the carriage frame,

As indicated at Fig. 6, the transverse sleeve 44 is fitted with a fluid-tight lining sleeve 104, the opposite ends of which are closed by plugs 105, 106. The end plug 106 is centrally bored and fitted with a suitable seal device 107 to accommodate in sliding relation a piston rod element 108 arranged to travel within the sleeve 104. The outer end of the rod 108 is connected as indicated at 109 to a brace rod 110 which extends rigidly from the upper end of the boom member 32, whereby it will be understood that displacement of fluid within the sleeve 104 will cause the sleeve

device 44 to be correspondingly reciprocated within the eye portion 46 at the upper end of the boom member in directions transversely of the longitudinal axis of the carriage unit. Suitable hydraulic fluid inlet-outlet connections are provided at opposite ends of the cross slide cylinder, such as are indicated at 112—113 (Fig. 6).

Thus, it will be appreciated that whenever a weapon is loaded upon the truck 10 and the boom device of the unit 15 is lowered as to the broken line position thereof shown in Fig. 1, the unit 15 may be backed up so as to dispose the lifting platform top plate 67 thereof in lifting position under the frame of the truck 10 at approximately the longitudinal position of the center of gravity of the load. Then, upon operation of the boom control cylinder 40, the boom may be elevated so as to carry the load upwardly, as to the solid line position of the parts as illustrated in Fig. 1. In order to insure firm positioning of the truck 10 upon the lifting platform plate 67, the truck frame will preferably include at the under surface thereof a box-shaped flange formation 114 into which the platform top plate 67 is adapted to slip-fit. Thus, with the load elevated as to the solid line position thereof shown in Fig. 1, the unit 15 may be towed by means of a tractor or the like to the position of loading or testing of the weapon.

For example, as illustrated in Fig. 1, if the problem is to load the weapon into connection with carrying shackles 115 extending from the underside of an airplane wing as indicated at 116, the unit 15 will first be drawn into the approximate estimated location thereof for loading of the weapon, and then the boom device will be caused to elevate so as to bring the weapon up into proximity with the airplane wing shackles. As the weapon is elevated toward the position of the shackles 115, the positional alignment of the weapon relative to the shackles is checked, and alignment corrections effected as follows. Minor fore and aft displacements of the weapon in directions longitudinally thereof may be effected by operation of the platform slide cylinder 94, while lateral displacements of the weapon may be effected by operation of the cross slide cylinder 104. Pitch adjustments of the weapon may be readily effected by operation of the platform tilting cylinder 60, and azimuth adjustments of the weapon may be reailly effected by manual operation of the worm gear control crank 74.

Also, the weapon may be rolled about its longitudinal axis, if required for accurate alignment with the connecting shackles, by manual operation of the truck roller hand crank 24. Thus, the weapon is universally maneuverable in attitude as well as displacement relative to the connecting shackles carried by the airplane wing or bomb bay, as the case may be.

In order to maintain the load carrying platform in an approximately horizontal attitude at all times during elevating and lowering of the carriage boom, the platform tilt control cylinder is hydraulically interconnected with an equalizer cylinder 120 (Figs. 1 and 5) which is pivotally fixed at one end to a bracket 121 carried by the vehicle frame. The piston rod 122 of the cylinder 120 pivotally connects at 123 to an intermediate portion of one of the stiff arm struts 42 of the boom truss structure, whereby whenever the boom pivots about the aligned pins 33—33 the piston rod 122 is correspondingly displaced relative to the cylinder 120. Conduits interconnecting opposite ends of the cylinders 60 and 120 provide for displacement of fluid in the tilt cylinder 60 coincident with displacement of fluid within the cylinder 120; and the connection between the piston rod 122 and the strut arm 42 is so arranged that the cylinder 120 will control the cylinder 60 to automatically pivot the load platform relative to the boom so as to at all times maintain a substantially horizontal attitude, coincident with elevating and lowering movements of the boom. However, as will be explained more fully hereinafter, the operator is at all times in possession of independent control of the tilt control cylinder 60, whereby the load may be adjusted about the pitch axis thereof by manipulation of the control system to be described hereinafter.

As illustrated at Figs. 1 and 5 of the drawing, a loading position indicator may be provided in conjunction with the trailer unit; said indicator comprising a stiff wand 125 which is mounted by means of an upright 126 extending into fixed connection with any suitable bracket portion of the vehicle frame. The wand and its mounting structure is so shaped and dimensioned that the ball tip end portion 128 thereof indicates the exact position to which the front bomb shackle lug of the weapon is lifted when the boom is elevated, as shown for example in Fig. 1. Thus, the trailer and its weapon load may be maneuvered around beneath the airplane bomb bay or wing until the ball tip end of the wand touches the front hook of the wing shackle. The trailer may then be parked with its brakes set, and the load then elevated with assurance that it will arrive at correct position for connection with the shackles on the wing, requiring only minimum final movements of the lifting platform relative to the boom as explained hereinabove.

As shown in Fig. 3, a pulling hook 130 may be conveniently mounted upon the platform structure so as to be readily available for connection to any suitable towing device, whereby the unit may be employed for miscellaneous towing purposes. Also, as shown in Figs. 3 and 6, a lifting eye 132 may be conveniently mounted under the top end portion of the boom 32 for engagement with suitable hook or other lift devices, whereby the boom may be used for miscellaneous lifting purposes as well as for initially grappling a weapon and lifting it from a stock pile or the like into position upon the truck 10 for subsequent handling as explained hereinabove.

Fig. 9 is a basic or simplified diagram of a hydraulic control system for the actuator elements of the mechanism described hereinabove. Thus, the diagram includes a fluid supply tank 134, a pump 135, and a manifold conduit system 136 delivering fluid under pressure to the intake ports of control valves 137, 138, 139, 140. As shown in Fig. 4, the control valve actuator elements may be conveniently mounted upon a panel carried adjacent the load platform so that the operator thereof may stand at a position providing at the same time convenient access to the control valves and to the weapon shackling operation.

Referring again to Fig. 9, the control valves 137, 138, 139, 140 are of the "four way" or reverse direction type and are hydraulically connected respectively to the hydraulic jack units 40, 60, 94, and 104 by means of suitable conduits so that the control valves may be selectively operated to provide controlled actuation of the jack devices in either direction of operation thereof as required for the weapon maneuvering operations referred to hereinabove. A return conduit 142 is arranged to convey the returning fluid to the supply tank 134. Furthermore, as shown in Fig. 9, the boom

actuated equalizer jack device 120 is hydraulically interconnected with the actuator jack 60 for the automatic platform control operation explained hereinabove.

It will of course be appreciated that in actual practice the hydraulic control system of Fig. 9 may preferably be supplemented by suitable pressure accumulator and overload relief devices as well as fluid filter and other such suitable accessories as are well known in the hydraulic operator art; and that the pump mechanism of the unit may be of any preferred type and may be driven from any suitable power source for the operation as explained. On the other hand, it will also be understood that the various operations of the elements of the unit of the invention may be otherwise powered by any suitable power supply means, and that all or any of the motion actuator mechanisms may be either manually or mechanically or electrically powered, as may be preferred.

I claim:

1. A weapons handling unit comprising a mobile boom device having a load lifting end portion, a platform mounted upon said boom portion for rotation thereon about a pitch change axis parallel to the axis of boom elevation, a hydraulic jack device interconnecting said boom and said platform for rotating the latter relative to said boom, a second hydraulic jack device connected to said boom for elevating the latter, a third hydraulic jack device interconnecting said frame and said boom for actuation in response to movement of said boom and hydraulically interconnected with said first mentioned jack device whereby displacement of fluid within said third jack device causes automatic operation of said first jack device to maintain said platform substantially horizontal throughout all elevating movements of said boom, a carriage comprising a frame supported upon ground wheels and adapted to be loaded with a weapon and towed from place to place and to mount upon said platform in positionally rigid attitude thereon, said carriage including paired roller devices adapted to receive in cradled relation therebetween a generally cylindrical weapon, means for rotating said roller means for rolling said weapon relative to said carriage about the longitudinal axis of said weapon, means for rotating said platform relative to said boom independently of actuation of said platform in response to operation of said third jack device, means for rotating said platform in azimuth relative to said boom, means for displacing said platform in directions horizontal longitudinally of said boom, and means for displacing said platform relative to said boom in horizontal directions transverse to the longitudinal direction of said boom.

2. A weapons handling unit comprising a mobile boom device having a load lifting end portion, a platform mounted upon said boom portion for rotation thereon about a pitch change axis parallel to the axis of boom elevation, a hydraulic jack device interconnecting said boom and said platform for rotating the latter relative to said boom, a second hydraulic jack device connected to said boom for elevating the latter, a third hydraulic jack device interconnecting said frame and said boom for actuation in response to movement of said boom and hydraulically interconnected with said first mentioned jack device whereby displacement of fluid within said third jack device causes automatic operation of said first jack device to maintain said platform substantially horizontal throughout all elevating movements of said boom, a carriage mounted upon said platform in positionally rigid attitude thereon and including paired roller devices adapted to receive in cradled relation therebetween a generally cylindrical weapon, means for rotating said roller means for rolling said weapon relative to said carriage about the longitudinal axis of said weapon, means for rotating said platform relative to said boom independently of actuation of said platform in response to operation of said third jack device, means for rotating said platform in azimuth relative to said boom, means for displacing said platform in directions horizontal longitudinally of said boom, and means for displacing said platform relative to said boom in horizontal directions transverse to the longitudinal direction of said boom and along an axis coincident to said pitch change axis.

3. A weapons handling unit comprising a mobile frame carrying thereon a pivoted boom device having a load lifting end portion, means for pivoting said boom relative to said frame, a platform mounted upon said boom for rotation thereon about a first axis parallel to a second axis of boom pivoting, a first hydraulic actuator interconnecting said boom and said platform for rotating the latter relative to said boom about said first axis, a second hydraulic actuator interconnecting said frame and said boom for actuation thereby in response to movement of said boom and interconnected with said first hydraulic actuator by means of a closed hydraulic conduit circuit whereby pivoting of said boom causes automatic operation of said first actuator to maintain said platform substantially horizontal throughout all movements of said boom, a base plate pivoted to said platform for rotation thereon in azimuth, a carriage adapted to mount said base plate and including roller devices adapted to receive in cradled relation therebetween a generally cylindrical shaped weapon, means for rotating one of said roller devices for rolling said weapon relative to said carriage about the longitudinal axis of said weapon, means for rotating said base plate in azimuth relative to said platform, means for displacing said platform relative to said boom in horizontal directions longitudinally of said boom, and means for displacing said platform relative to said boom in horizontal directions transverse to the longitudinal direction of said boom.

4. A weapons handling unit comprising a mobile boom device having a load lifting end portion, a platform mounted upon said boom portion for rotation thereon about a pitch change axis parallel to the axis of boom elevation, an actuator device interconnecting said boom and said platform for rotating the latter relative to said boom, a second actuator connected to said boom for elevating the latter, a third actuator interconnecting said frame and said boom for actuation in response to movement of said boom and interconnected with said first mentioned actuator whereby to cause automatic operation of said first actuator to maintain said platform substantially horizontal throughout all elevating movements of said boom, a carriage mounted upon said platform in positionally rigid attitude thereon and including paired roller devices adapted to receive in cradled relation therebetween a generally cylindrical weapon, means for rotating said roller means for rolling said weapon relative to said carriage about the longitudinal axis of said weapon, means for rotating said platform relative to said boom independently of actuation of said platform in response to operation of said third actuator,

means for rotating said platform in azimuth relative to said boom, means for displacing said platform in horizontal directions longitudinally of said boom, and means for displacing said platform relative to said boom in horizontal directions transverse to the longitudinal direction of said boom and along an axis coincident to said pitch change axis.

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