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Thompson

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[54] **MATERIAL HANDLING EQUIPMENT**

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[73] Assignee: **R. E. Barker & Co.,** Yorkshire, England

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[21] Appl. No.: **343,941**

[52] **U.S. Cl.** **214/620,** 214/730, 214/731

[51] **Int. Cl.** **B66f 9/14,** B66f 9/16

[58] **Field of Search** 214/620, 730, 731, 750

[56] **References Cited**

UNITED STATES PATENTS

2,780,377	2/1957	Glenn, Jr. et al.	214/620 X
3,096,896	7/1963	Norton et al.	214/620 X
3,106,305	10/1963	Gehring	214/620 X
3,738,512	6/1973	Marsden	214/730

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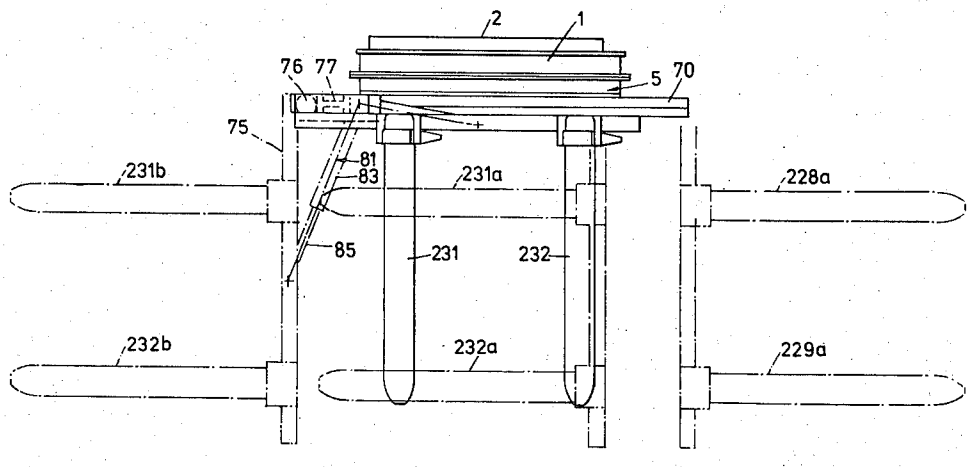
Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

An attachment for a lifting vehicle, comprising a rear frame having means for attachment to a vehicle, a mid-frame rotatably mounted on the rear frame for rotation relative thereto about an axis substantially perpendicular to the plane of the rear frame, a front plate hinged at one side thereof to the mid-frame, means for opening and closing the hinge to pivot the front plate away from and towards the mid-frame, means for moving the hinge longitudinally of the mid-frame from side to side thereof and mounting means at both opposite longitudinal edges of the front plate to which material handling members may be attached.

10 Claims, 9 Drawing Figures



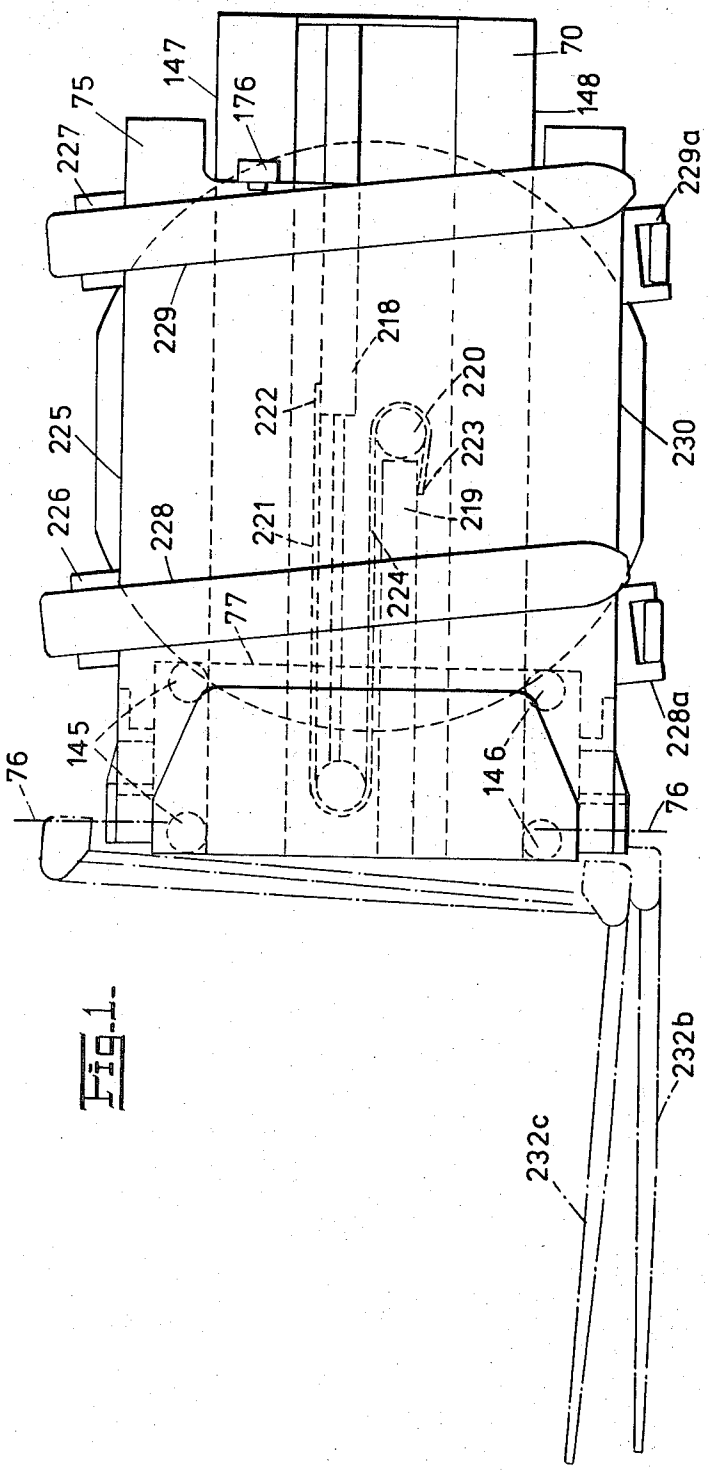

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Fig. 1

Fig. 2.

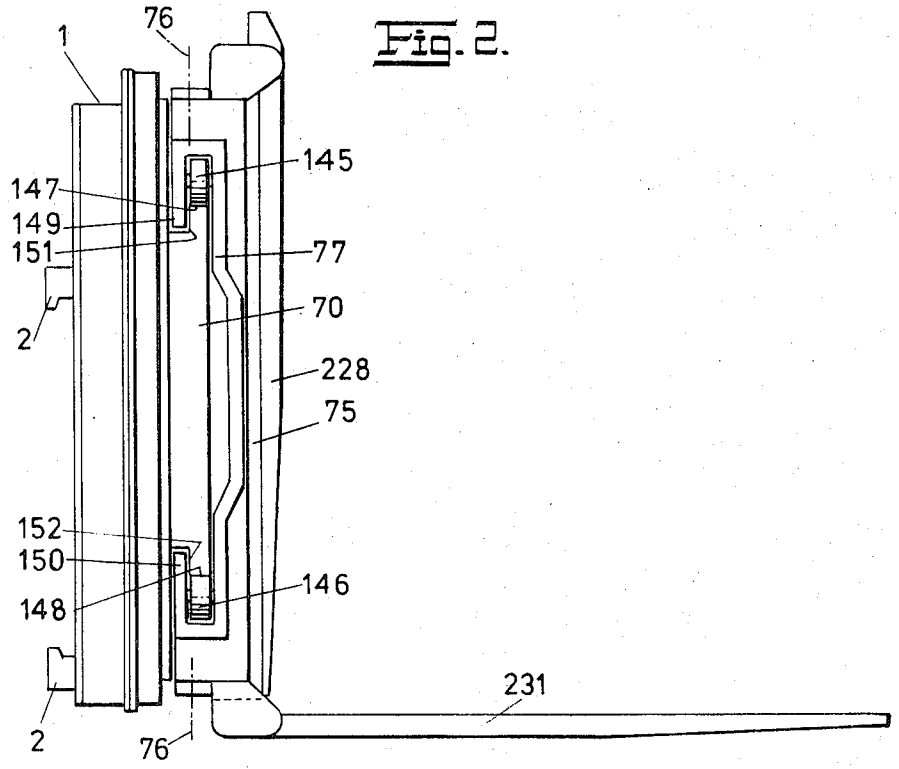
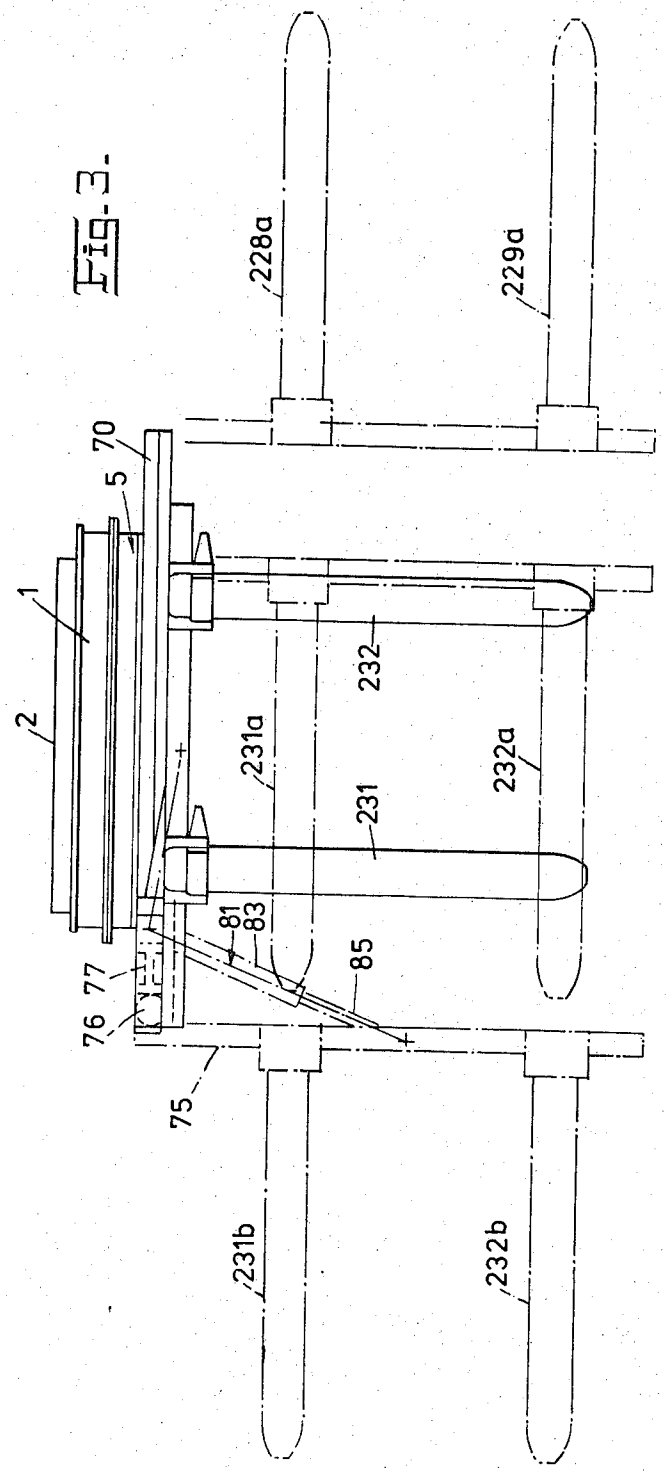


Fig. 3.



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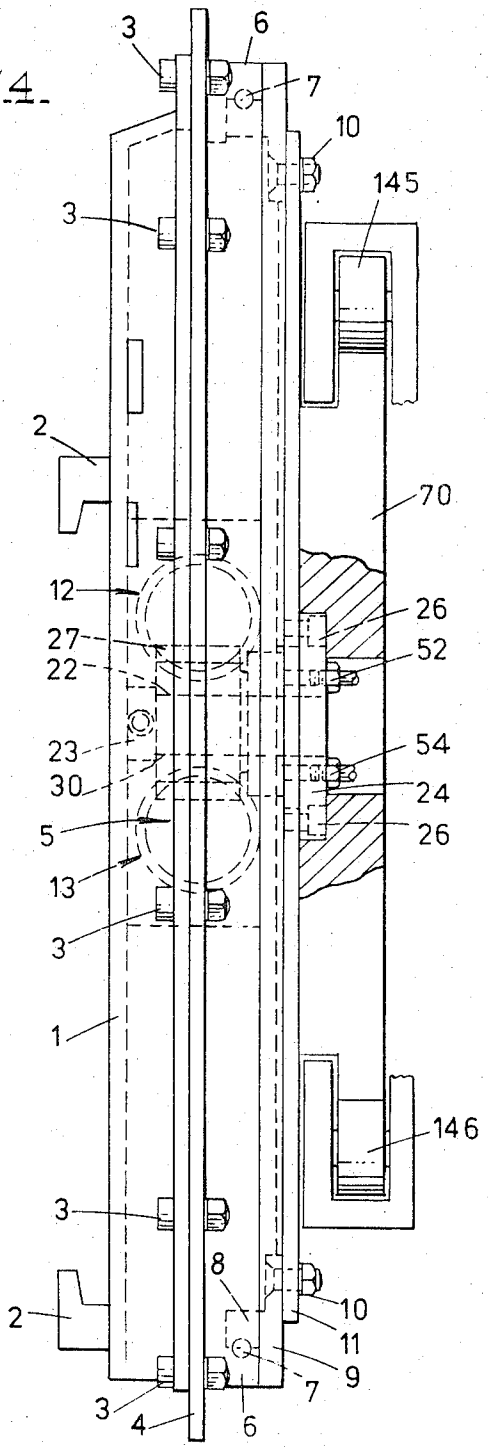
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Fig. 5.

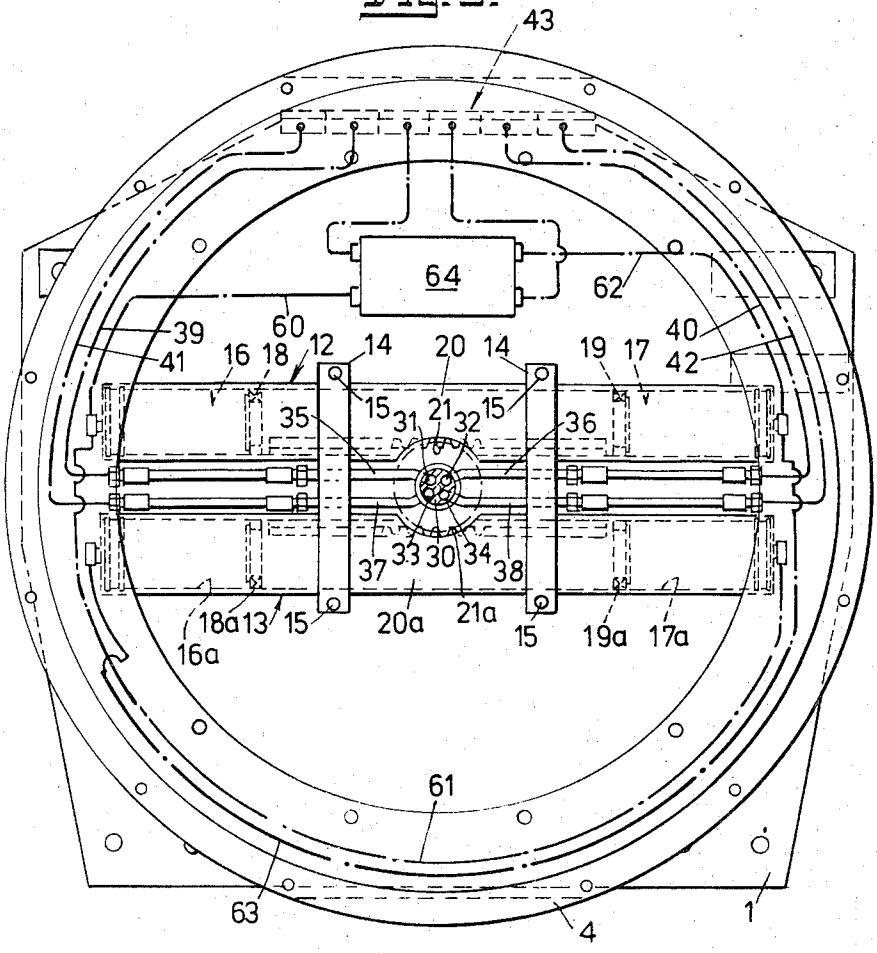
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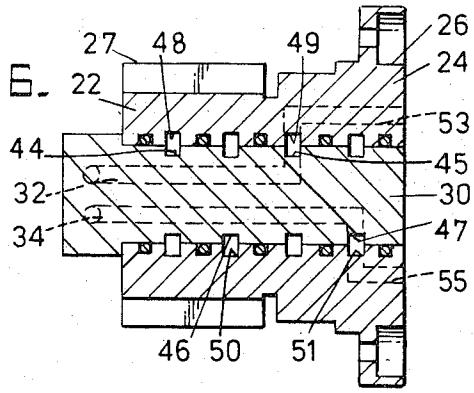
Fig. 6.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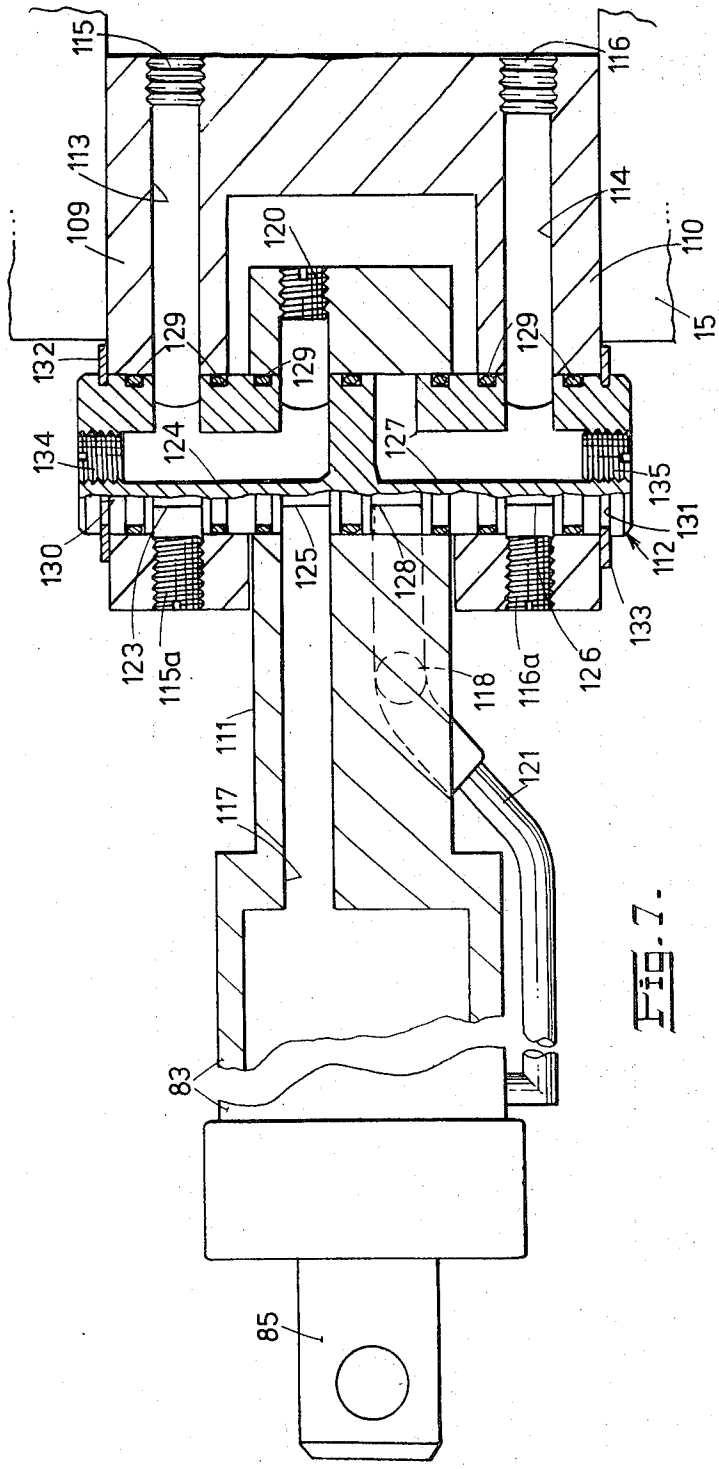
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Fig. 7.

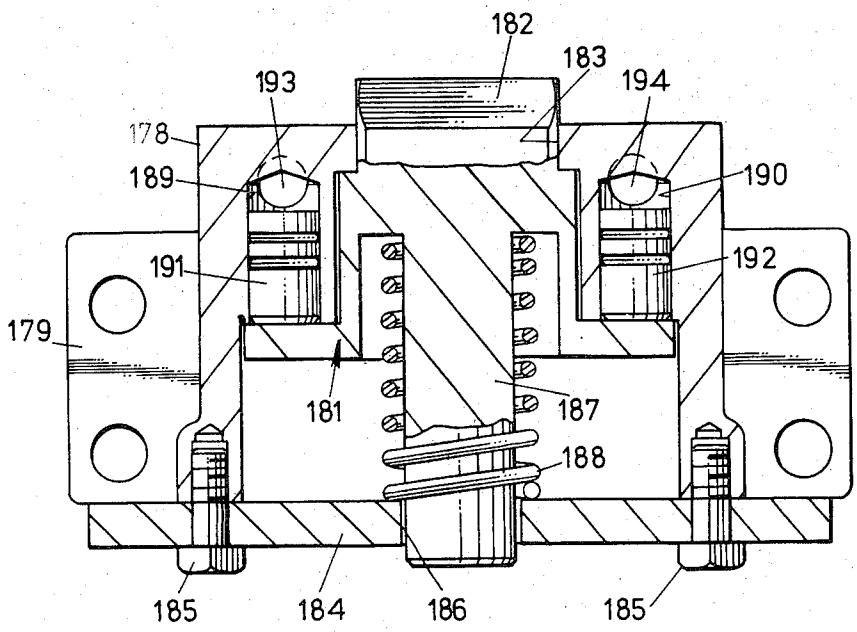
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Fig. 8.

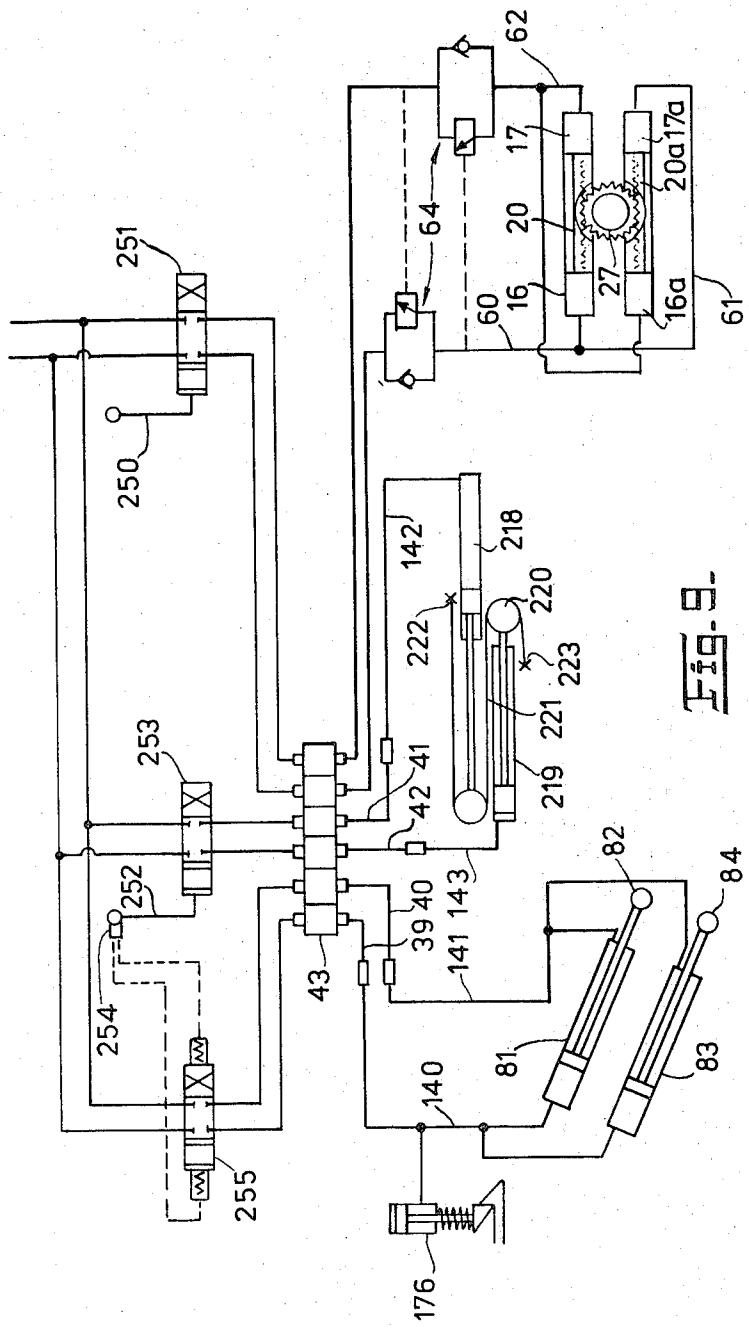
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Fig. 9.

MATERIAL HANDLING EQUIPMENT

This invention relates to material handling equipment, and more particularly to an attachment for fork lift trucks and other lifting vehicles and to vehicles equipped with such an attachment.

The load carrier of a fork lift truck is generally directly mounted in the carriage plate which is slidably mounted for vertical movement up and down the mast. On such trucks there is no provision for pivoting the load carrier out of its straight-ahead position to project toward either side of the truck. Such a facility is useful for handling loads to each side of a narrow aisle along which the truck can move only forwards and backwards.

A number of attempts have been made to provide fork lift trucks or attachments therefor which will provide this facility. These have generally relied upon frames placed one in front of another and pivotally connected one to another so that the more forward frames may be pivoted on the more rearward ones from a position pointing straight ahead of the truck to positions pointing to either side of the truck. The present invention proposes an alternative construction for the attachment which has certain advantages over the known attachments.

According to the present invention an attachment for a lifting vehicle, particularly a fork lift truck, comprises a rear frame having means for attachment to a vehicle, a mid-frame rotatably mounted on the rear frame for rotation relative thereto about an axis substantially perpendicular to the plane of the rear frame, a front plate hinged at one side thereof to the mid-frame, means for opening and closing the hinge to pivot the front plate away from and towards the mid-frame, means for moving the hinge longitudinally of the mid-frame from side to side thereof and mounting means at both opposite longitudinal edges of the front plate to which material handling members may be attached.

The invention also includes a vehicle having an attachment as aforesaid fitted thereto. The vehicle may preferably be a fork lift truck, in which case the attachment means on the rear frame are means for securing that frame to the standard carriage plate of the fork lift truck. The front plate may have mounting means for any contemplated variety of forks, arms and other material handling members.

In normal use, assuming that the attachment is fitted to the standard carriage plate of a fork lift truck, the front plate is folded back to lie parallel with and ahead of the mid-frame, with the hinge positioned at one edge of the mid-frame and the mid-frame and front plate lying substantially within the same confines when viewed forwardly from the truck. The front plate has first and second longitudinal edges respectively uppermost and lowermost and extending substantially horizontally, and material handling members are fixed to the mounting means associated with the second (lowermost) edge. The truck can thus operate as a conventional fork lift truck.

Assume now that, looking forward from the driving position, the hinge is at the right hand side of the mid-frame and it is desired to side stack to the right of the truck. To do this the hinge is opened to move the front plate to take up a position projecting forwardly from, and at right angles to, the mid-frame. The load handling members then project to the right of the truck, and by

traversing the hinge across the mid-frame from its limit right hand to its limit left hand position the load handling members can be moved between positions projecting beyond the sides of the mid-frame or lying within the limits of the mid-frame.

To side stack to the left of truck, from the normal operating position described, the mid-frame is first rotated through 180° on the rear frame to invert the mid-frame and front plate and position the hinge at the left hand side of the mid-frame. The load handling members on the second (now the uppermost), longitudinal edge of the front plate are removed or rendered inoperative, and load handling members on the first (now the lowermost) longitudinal edge of the front plate are fitted or rendered operative. Opening of the hinge will thus pivot the load handling members to the left of the truck, and traversing of the hinge on the mid-frame may again be effected.

Preferably the attachment is such that pivotal movement of the front plate away from the mid-frame occurs simultaneously with longitudinal movement of the hinge across the mid-frame. Thus, the load handling members can be turned from a front facing to a side facing position within the confines of the length of the attachment. Conversion to side-stacking can thus be effected in narrow aisles.

When a load is being handled in a side stacking position it is desirable for the load to be tilted towards the attachment to improve stability, and it will be seen that a small rotational movement of the mid-frame on the rear frame can readily achieve this effect.

Conveniently the mounting means for the load handling members include hinges to which the load handling means are secured so that when the hinges are on the uppermost edge of the front plate the load handling members hang down substantially parallel to and in contact with the front plate, and when the hinges are on the lowermost edge of the front plate the load handling members project forwardly from the front plate and substantially normal thereto. Thus, as the attachment is rotated from a right side stacking form to a left side stacking form or vice versa one set of load handling members will fall by gravity about their hinges to an out of use position, and the other set will fall by gravity about their hinges to an in use position.

In order that the invention may be fully understood a specific embodiment of an attachment according to the invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

FIG. **1** is a front elevation of a fork lift truck attachment according to the invention;

FIG. **2** is a side elevation of the attachment;

FIG. **3** is a plan view of the attachment;

FIG. **4** is a part side elevation, part section of a rotator used in the attachment;

FIG. **5** is a front elevation of the attachment with parts removed;

FIG. **6** is a cross-section through a detail part of the attachment;

FIG. **7** is a cross-section through a hinge;

FIG. **8** is a cross-section through a locking device; and

FIG. **9** is a fluid circuit diagram.

As shown in the drawings the attachment comprises a rear frame **1** provided with mounting members **2** for mounting on the conventional carriage plate of a fork

lift truck. Secured to the rear frame by bolts **3** is a back plate **4** of a rotator assembly **5**, and secured to the back plate **4** is the outer race **6** of a large diameter ball bearing slewing ring having balls **7**. The inner race **8** of this ring is fixed to an annulus **9** which is bolted by bolts **10** to a front member **11** of the rotator assembly.

The rotator assembly includes two hydraulic ram units **12, 13** each secured to the back plate **4** by mounting strips **14** and bolts **15**. The two ram units are identical, and only unit **12** will be described in detail, identical components of unit **13** being shown by the same reference numerals with the suffix *a*. Unit **12** includes two opposed single-acting cylinders **16, 17** in each of which there is a piston **18, 19**, the two pistons being joined by a common piston rod **20**, part of which is formed with teeth to constitute a rack section **21**.

Passing between the two ram units **12, 13** is a hollow shaft **22** carrying at one end a disc **24** secured by bolts **26** to the front member **11** and carrying at the other end a pinion **27** which is in mesh with the two rack sections **21, 21***a*. The rack sections are shown in their mid-positions in FIGS. **5** and **9** but it will be understood that they will normally lie one at an extreme left-hand position and one at an extreme right-hand position. The hollow shaft **22** can rotate about a pin **30** (FIG. **5**) having four axial channels **31** to **34** formed therein for carrying hydraulic fluid. The four channels are connected to respective ones of four pipes **35** to **38** which are in turn connected to pipes **39** to **42** leading to a connection block **43** mounted on the rear frame.

The four channels **31** to **34** each open into an annular groove **44** to **47** formed around the pin **30** and communicating with channels **48** to **51** formed in the inner surface of the hollow shaft **22**. These channels communicate with axial passages **52** to **55** through the shaft **22**, hose connection nipples being provided at the ends of these passages.

Hydraulic fluid lines **60** and **61** are connected to the cylinders **16** and **17***a*, these lines being connected and passing to a surge prevention valve **64** and thence to the connection block **43**. Hydraulic fluid lines **62** and **63** are connected to the cylinders **17** and **16***a*, these lines being connected and passing to the valve **64** and connection block **43**. It will be understood that when hydraulic fluid is admitted into opposite cylinders of the ram units the rack sections **21, 21***a* will move and will rotate the pinion **27**, so causing the front member **11** to rotate relative to the back plate **4**.

Secured to the front member **11** of the rotator assembly is a mid-frame **70**, and secured to the mid-frame **70** is a front plate **75** which is hinged about an axis **76** to a carrier plate **77**. The front plate **75** thus may be pivoted away from and towards the mid-frame **70** by two vertically spaced hydraulic rams **81** and **82**, each comprising a cylinder **83, 84** pivoted to the carrier plate **77** and a piston rod **85, 86** pivoted to the front plate **75**.

The cylinders are identical, and each cylinder terminates in a stem **111** (FIG. **7**) which fits between two opposed clevis sections **109, 110** on the carrier plate **77**, the stem and clevis being drilled to receive a hinge pin **112** formed to have lands and grooves and also formed to have axial passages for fluid transmission. The clevis sections **109, 110** are each drilled to form a fluid passage **113, 114**, the passages being tapped at **115, 116** to receive hose connections, and being closed by plugs **115***a*, **116***a* at their other ends. Passages **115** and **116** are connected respectively by flexible hose, **140, 141** to the hose connection nipples at the ends of passages **52** and **53**. The cylinder stem **111** is formed with two fluid passages **117, 118**, one opening directly into the fixed end of the cylinder, and the other opening out of the stem into a conduit **121**. The passages **117, 118** are drilled through from the exposed edge of the stem and these ends are then plugged by plugs such as **120**. The conduit **121** is secured externally of the cylinder and leads to the rod end of the cylinder where it is connected to a port in the cylinder wall opening into the rod end of the cylinder.

The passage **113** in clevis section **109** is aligned with and opens into a groove **123** in the hinge pin, and this groove communicates by an axial passage **124** with a further groove **125** sligned with the fluid passage **117**. A passage for fluid through the hinge pin from clevis section **109** to cylinder **83** is thus formed whatever the relative position of the parts. Similarly, groove **126**, axial passage **127** and groove **128** form a passage for fluid from clevis section **109** to cylinder **83**. Other grooves formed round the hinge pin house O-ring seals **129** for preventing fluid leakage along the outside of the pin. The pin is also formed with grooves **130, 131** receiving circlips **132, 133** for properly locating the pin and holding it in position relative to the clevis sections **109** and **110**. The axial passages **124** and **127** are drilled in from opposite ends of the hinge pin and the open ends closed by plugs **134** and **135**.

The carrier plate **77** is fitted with upper and lower pairs of rollers **145** and **146** which run on tracks **147** and **148** respectively formed on the mid-frame **70**. The carrier plate also has key sections **149** and **150** engaging in parallel keyways **151** and **152** formed on the mid-frame **70**.

Secured to the mid-frame **70** are two hydraulic rams **218** and **219** each having a piston rod with a chain wheel such as **220** mounted on the end thereof. A chain **221** extends from a fixed point **222** above ram **218**, around the chain wheel of ram **218** from this chain wheel to the chain wheel **220** of ram **219** and is anchored at **223** below the ram **219**. At a point on its run **224** between the two chain wheels the chain is anchored to the carriage plate **77**. Thus by extension and retraction of the rams **218** and **219** the carriage plate **77** can be driven longitudinally along the mid-frame **70**. The cylinders **218** and **219** are connected respectively by pipes **142, 143** to the hose communication nipples at the ends of passages **54** and **55**.

Secured to a first longitudinal edge **225** of the front plate **75** are two clevis mounting members **226** and **227** between which fit bosses of load handling forks **228** and **229** respectively, hinge pins passing through the associated clevises and bosses to pivotally mount the forks on the front plate **75**. A similar arrangement of clevises **228***a* and **229***a* is provided on the second longitudinal edge **230** of the front plate **75** and in these clevises are pivotally mounted bosses of further forks **231** and **232**. The pivotal axes of the forks on the clevises **226, 227, 228***a* and **229***a* are inclined to the longitudinal edges **225, 230** of the front plate **75** so that forks **228** and **231** will not contact each other when moving about their pivots and similarly forks **229** and **232** will not contact each other during pivotal movement.

A locking device **176** is mounted on the mid-frame **70** for locking the front plate **75** to the mid-frame. The lock is fluid-operated, being controlled by fluid pressure in conduit **140**. The lock comprises a substantially

rectangular housing **178** having mounting flanges **179** by way of which it may be bolted to the mid-frame. Slidably mounted in a chamber **180** in the housing is a plunger **181** having a latching end **182** normally projecting through a slot **183** in one end of the housing. The other end of the housing is closed by a cover plate **184** secured by bolts **185**, the cover plate having a slot **186** through which a stem **187** of the plunger projects. A compression spring **188** surrounds that part of the stem **187** that lies within the housing and biases the plunger so that the latching end **182** projects. Formed in the housing are two cylinders **189** and **190**, each having a piston **191**, **192** slidable therein. Tapped bores **193**, **194** open into the cylinders and fluid conduit connectors (not shown) are screwed into the open ends of the tapped bores and connected to the fluid supply conduit **100**. It will be evident that when fluid under pressure is admitted into the cylinders **189**, **190**, the plunger will be moved against the spring **188** to withdraw the latching end **182** into the housing. The latching end **182** of the lock **176** is engageable with the edge of the front plate **75**.

Operation of the attachment will now be described. This operation is effected by three controls, a lever **250** controlling a valve **251** for fluid to the rotator cylinders **16**, **16***a*, **17**, **17***a*, a lever **252** controlling a valve **253** for fluid to the cylinders **218**, **219** controlling traversing movement of the carrier **77** and front plate **75**, and a push-button **254** controlling a valve **255** for fluid to the cylinders **81** and **82** for pivoting the front plate on the carrier.

In operation when a fork lift truck to which the attachment is fixed is operating in its normal state with the forks pointing straight ahead then the attachment appears as shown in solid lines in FIGS. **1** to **3**. If it is desired to handle a load to the right hand side of the fork lift truck looking forward from the driving seat then lever **252** is moved to the right to allow fluid to flow through valve **253** to lines **42** and **143** to move the piston in cylinder **219** to the left hand side of the attachment, so causing the carrier **77** to traverse across the mid-frame **70**, carrying with it the front plate **75**. During this movement, fluid exhausts from cylinder **218** through lines **142** and **41**. Simultaneous operation of button **254** will allow fluid to flow through valve **255** to lines **39** and **140** to extend the pistons in cylinders **81** and **82** and so pivot the front plate **75** forwardly on the carrier **77**, fluid exhausting from behind the pistons in cylinders **81** and **82** through lines **141** and **40**. Carrying out these traversing and pivotal movements simultaneously ensures that the forks **231** and **232** will turn within the longitudinal confines of the attachment and will finally take up the positions shown as **231***a* and **232***a* in FIG. **3**. When in this position the forks can be moved to project to the right hand side of the truck by moving lever **252** to the left to change over valve **253** and cause fluid to extend the piston in cylinder **218** while fluid is exhausted from cylinder **219**. This causes traversing of the carrier frame **77** across the mid-frame **70** back to the right hand side thereof to place the forks in positions **231***b* and **232***b* as shown in FIGS. **1** and **3**. A load can thus be engaged by the forks in this position and after engagement of the load this may be tilted towards the attachment by a small rotational movement of the mid-frame **70** relative to the rear frame in a clockwise direction as shown in FIG. **1** to raise the forks to the position **232***c* shown in FIG. **1**. The rotation is effected by moving lever **250** to the right so that valve **251** directs fluid into cylinders **16** and **17***a*, and allows exhaust of fluid from cylinders **17** and **16***a*.

To convert the attachment to a left side stacking arrangement any load on the forks **231** and **232** is deposited and the front plate **75** is moved to lie parallel with and immediately ahead of the mid-frame **70** if not already in this position.

The lever **250** is then moved to the right so that valve **251** directs fluid into cylinders **16** and **17***a*, and allows exhaust of fluid from cylinders **17** and **16***a*. The rack sections **21**, **21***a* thus drive the pinion **25** and so the front plate **75** anticlockwise as seen looking forward from the driving seat, and such rotation is allowed to continue for 180°. As the front plate passes the dead centre position the surge prevention valve **64** acts to prevent any surge of fluid, and allows smooth rotation of the front plate to continue. After inversion it will be seen that the pivotal axis **76** has been moved from the right hand side to the left hand side of the attachment and the front plate has been inverted to place the longitudinal edge **225** lowermost and the longitudinal edge **230** uppermost. During inversion the forks **231** and **232** fall under gravity about their pivotal axes in clevises **228***a* and **229***a* to take up a vertical position against the front plate and the forks **228** and **229** fall under gravity about their pivotal axes to take up a horizontal operative position. After the inversion, side stacking to the left may be effected by operation of rams **81**, **83** to pivot the front plate away from the mid-frame and operation of rams **218** and **219** to move the carrier plate **77** across the mid-frame. Thus, forks **228** and **229** can be moved to the positions **228***a* and **229***a* shown in FIG. **3**. Once again any load on the forks may be tilted towards the centre of the attachment, this time by a small clockwise movement of the mid-frame on the rear frame.

Conversion to right side stacking is of course carried out in similar manner to that described, but controlling valve **251** so that fluid is admitted to cylinders **16***a* and **17** and exhausted from **16** and **17***a* so that the mid-frame rotates through 180° clockwise on the rear frame.

The attachment thus provides facilities for stacking to left or right of the fork lift truck without impeding normal forward position operation of the truck. The attachment also allows loads to be tilted towards the centre of the attachment to improve stability.

Although a rotator using racks and a central pinion has been described, it will be understood that other types of rotator may be used. For example the mid-frame may carry an externally toothed ring engaging a pinion rotatably mounted on the rear frame, the pinion being driven directly or through a reduction gear box from an hydraulic motor.

What I claim is:

1. An attachment for a lifting vehicle, comprising a rear frame having means for attachment to a vehicle, a mid-frame rotatably mounted on the rear frame for rotation relative thereto about an axis substantially perpendicular to the plane of the rear frame, a front plate hinged at one side thereof to the mid-frame, means for opening and closing the hinge to pivot the front plate away from and towards the mid-frame, means for moving the hinge longitudinally of the mid-frame from side to side thereof and mounting means at both opposite

longitudinal edges of the front plate to which material handling members may be attached.

2. An attachment according to claim **1** in which the attachment means are means for securing the rear frame to the standard carriage plate of a fork lift truck.

3. An attachment according to claim **1** in which first fluid-operated means are mounted on the rear frame, rack sections are operatively connected to said first fluid operated means to be driven longitudinally across the rear frame, a pinion engages said rack sections and is secured to said mid-frame whereby longitudinal movement of said rack sections causes said rotation of said mid-frame relative to said rear frame.

4. An attachment according to claim **3** in which the means for opening and closing the hinge are second fluid-operated rams having cylinders pivotally secured to a carrier plate movable longitudinally of the mid-frame from side to side thereof, and piston rods pivotally secured to the front plate.

5. An attachment according to claim **4** in which the carrier plate is moved longitudinally of the mid-frame by third fluid-operated rams.

6. An attachment according to claim **5** in which the third fluid-operated rams comprise two oppositely extending rams one above and longitudinally offset from the other, each having a cylinder secured to the mid-frame and a piston rod carrying a pulley at its free end, and a flexible element extends from an anchorage above the upper cylinder, around the pulley of the upper piston rod, between the levels of the piston rods, around the pulley of the lower piston rod and to an anchorage below the lower cylinder, the flexible element being secured to the carrier plate in its run between the two pulleys.

7. An attachment according to claim **5** in which the pinion is fixed to a hollow shaft rotatably mounted about a pin secured to the rear frame, and fluid for the second and third fluid-operated rams is transmitted from conduits on the rear plate to conduits on the mid-frame by communicating axial and radial channels formed in the pin and the hollow shaft.

8. An attachment according to claim **5** in which supply of fluid to the second and third fluid-operated rams is controlled so that whenever there is pivotal movement of the front plate away from the mid-frame there is simultaneous longitudinal movement of the carrier plate on the mid-frame.

9. An attachment according to claim **1** in which the mounting means for the load handling members include hinges to which the load handling means are secured so that when the hinges are on the uppermost edge of the front plate the load handling members hang down substantially parallel to and in contact with the front plate, and when the hinges are on the lowermost edge of the front plate the load handling members project forwardly from the front plate and substantially normal thereto.

10. An attachment according to claim **9** in which the pivotal axes of the hinges are inclined to the longitudinal edges of the front plate so that load handling members mounted on the hinges will not contact each other when moving about their hinges.

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