Jan. 29, 1963 O. E. BIHR 3,075,663

CLAMP ATTACHMENT

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FIG. 1

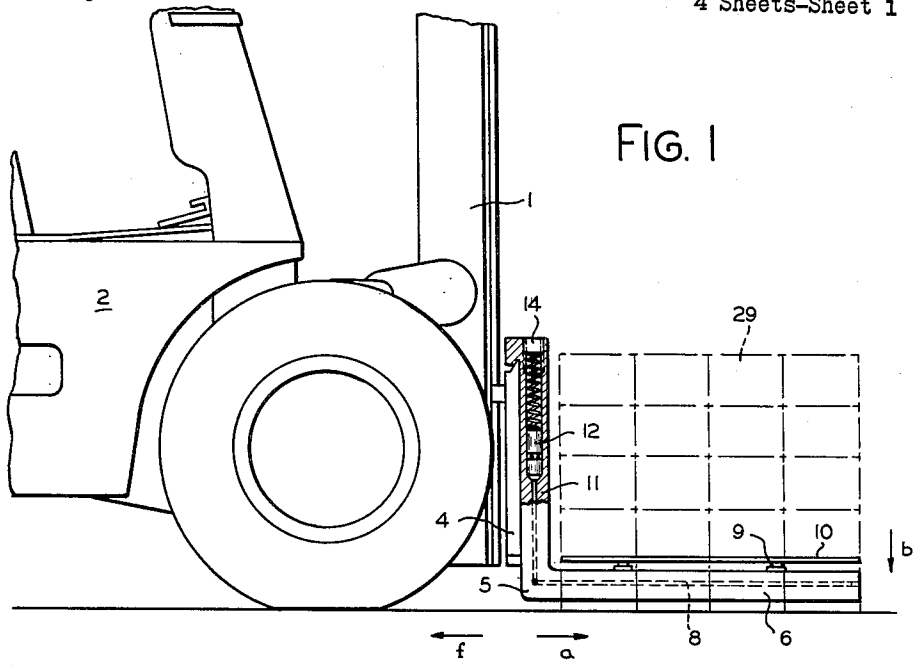

FIG. 2

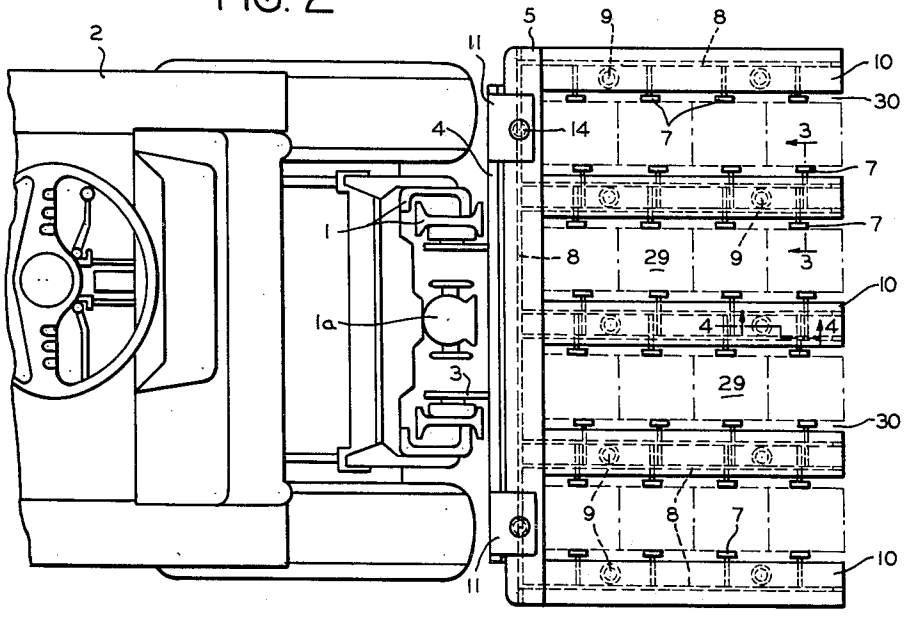

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FIG. 4

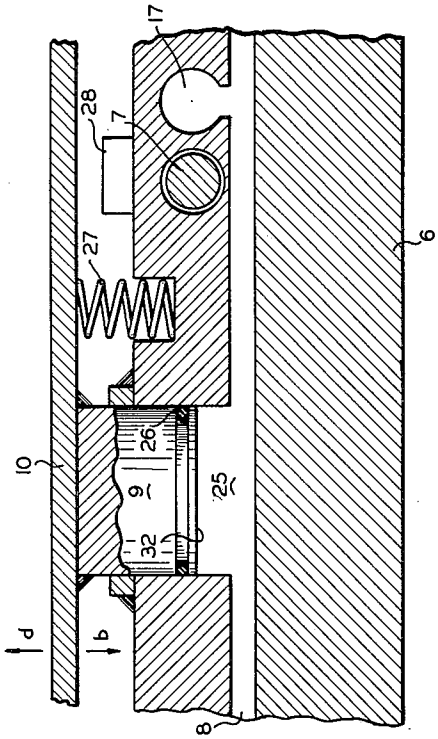


FIG. 7

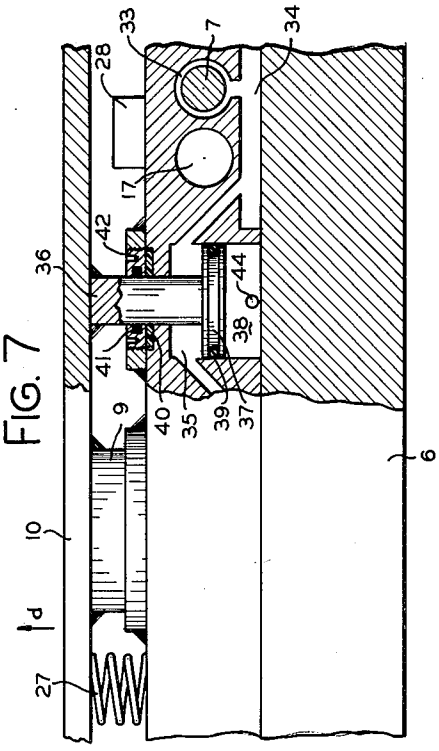


FIG. 3

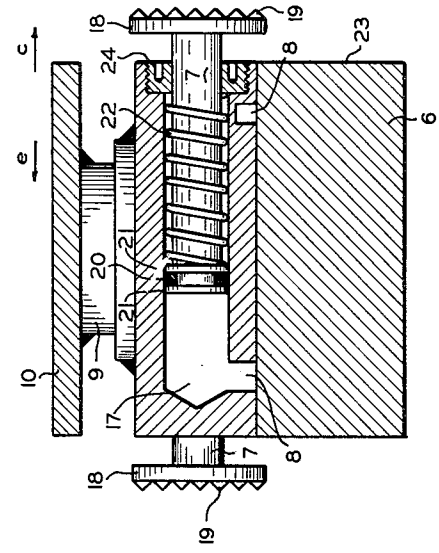
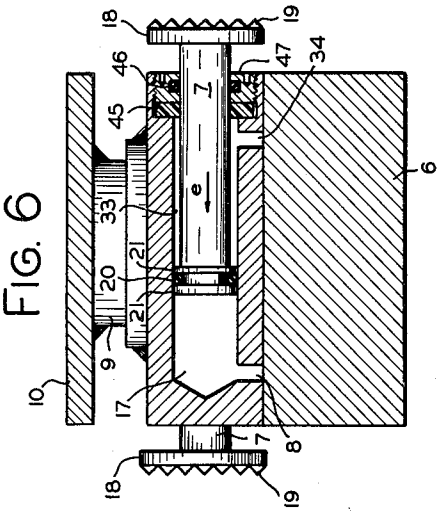


FIG. 6



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CLAMP ATTACHMENT

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FIG. 5

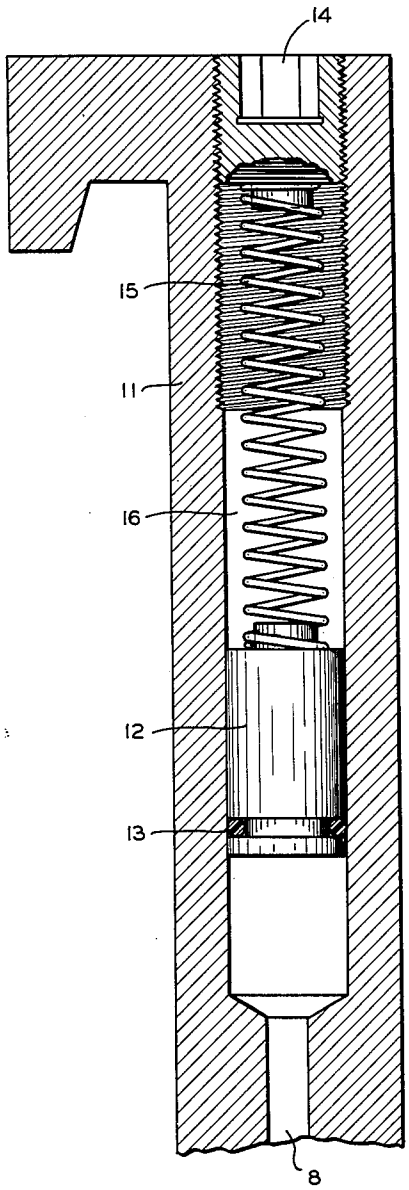

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FIG. 8

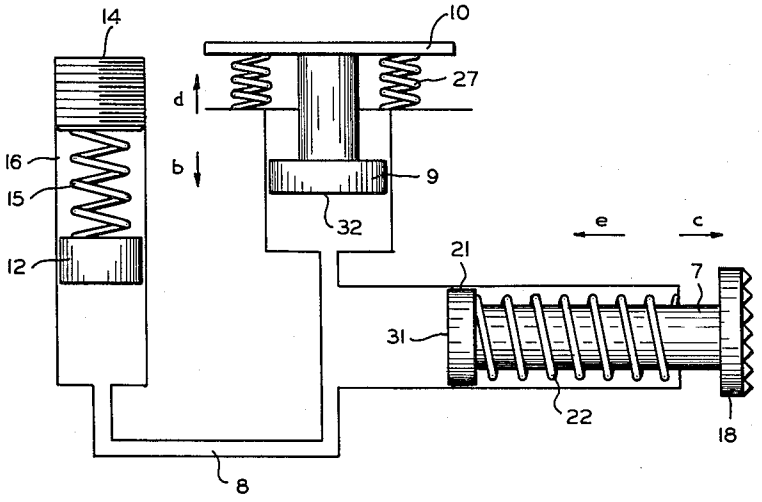
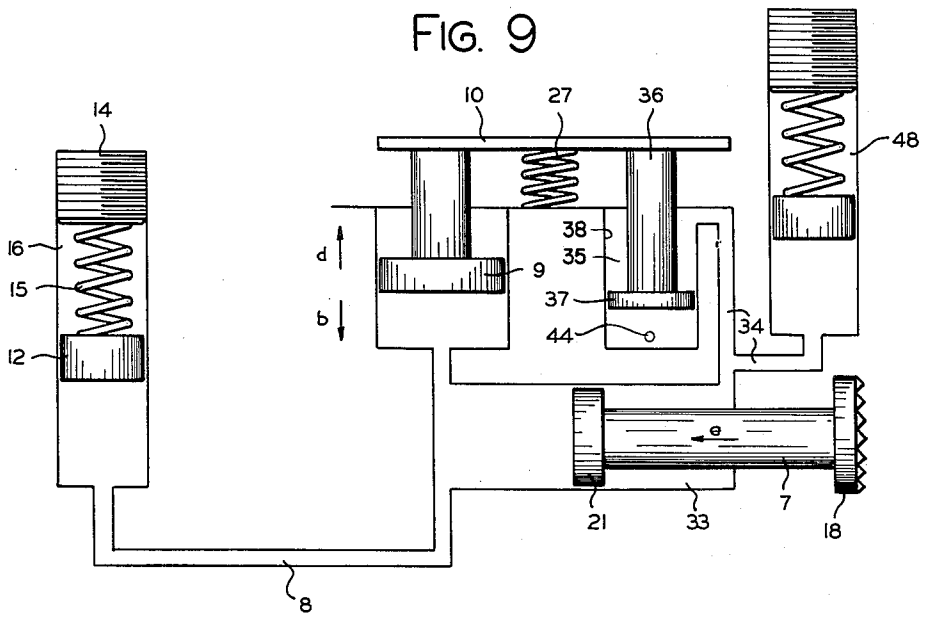


FIG. 9



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3,075,663

CLAMP ATTACHMENT

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Claims priority, application Germany June 3, 1959
7 Claims. (Cl. 214—655)

This invention relates to an attachment for industrial trucks, and more particularly to improvements in a clamping attachment for lift trucks which is especially suited for handling stacks of building blocks, bricks, and the like wherein at least two laterally spaced fork arms are provided having facing sides equipped with clamping members for engaging and holding material to be conveyed.

Heretofore, it has been generally known to provide facing clamp members in fork arms of the type contemplated in which the clamp members are responsive to hydraulic or pneumatic fluid pressure supplied by a main pressure generating system, including a pump or compressor, which is connected to the engine of the lift truck.

It is an important object of the present invention to provide a generally improved clamping mechanism of the type under consideration. This is achieved in large part by connecting clamping members with a closed pressure system which may be filled with a hydraulic or pneumatic pressure-transmission medium in which pressure responsive members, such as pistons, are actuated by the mass of material to be conveyed to provide fluid pressure at the facing clamping members located in the sides of fork arms. When the material conveyed is deposited the pressure members automatically release the clamping members. The device of the present invention is, therefore, capable of engaging, conveying and depositing material without dependency upon any independent pressure generating means, such as a pump or air compressor. An additional resulting advantage in the use of a hydraulic pressure-transmission medium, for example, is that hydraulic lines between the fork arms, which is preferably movable vertically in a lifting mast of a lift truck, and a stationary pump are eliminated. Thus, the attachment unit becomes a less cumbersome and neater package, and by omission of the usual movable connecting hydraulic lines the unit is less subject to malfunctioning in operation and, importantly, is insensitive to fluid losses resulting from leakage in the independent system.

If desired, the pressure transmitting system between the pressure producing pistons and the pressure responsive clamping members may be filled with a mechanical pressure transmission medium as, for example, steel balls, which is of particular advantage in applications which require that the pressure transmission medium be insensitive to large variations in temperature. The use of steel balls in the aforesaid manner as an alternative to the use of fluid, hydraulic or otherwise, makes possible the use of the attachment in areas of widely varying temperature. Also, of course, no leakage losses are encountered in the use of a mechanical pressure transmission medium.

The fork arms are preferably equipped with pressure limiters to limit the maximum clamping pressure which can be applied to the material conveyed, thereby protecting same against possible damage. Also, adjustable pressure reservoirs in the system are provided so that the operating pressure of the pressure transmission medium can be varied as desired depending upon requirements of different operating conditions.

Another object of the invention is therefore to provide a closed circuit pressure transmission system in a clamping attachment of the type contemplated wherein means are provided to apply clamping pressure as a function of the load to be conveyed and to release such clamping pressure upon deposite of the load.

Other objects and advantages of the present invention will appear as the description proceeds.

Now, in order to acquaint those skilled in the art with the manner of constructing and using clamping means, in accordance with the principles of my present invention, I shall describe in connection with the accompanying drawings, preferred embodiments of the invention.

In the drawings:

FIGURE 1 is a side view primarily in elevation which illustrates the clamping attachment suspended on the lifting mast of an industrial truck;

FIGURE 2 is a plan view of FIGURE 1;

FIGURE 3 is an enlarged vertical longitudinal section through a fork arm along the line 3—3 in FIGURE 2;

FIGURE 4 is an enlarged vertical longitudinal section through a fork arm along the line 4—4 in FIGURE 2;

FIGURE 5 is an enlarged vertical section through a pressure reservoir shown in section in FIGURE 1;

FIGURE 6 is a vertical section similar to FIGURE 3 but illustrating a modified form of the invention;

FIGURE 7 is a vertical section similar to FIGURE 4 but illustrating another portion of the modified form of the invention shown in FIGURE 6;

FIGURE 8 is a schematic representation of the form of the invention shown in FIGURES 3 and 4; and

FIGURE 9 is a schematic representation of the modified form of the invention shown in FIGURES 6 and 7.

Referring now in detail to the drawings, a lifting mast assembly **1** is supported in well-known manner upon the forward end of an industrial truck **2** and supports in turn for vertical movement therein a lift bracket **3** to which is connected a transverse support plate **4**. Hydraulic hoist motor means **1***a* is associated with the lifting mast **1** and is connected by known sprocket and chain means with a transverse plate **4** for actuating same vertically in lifting mast **1** in a well-known manner.

A conveyor fork arm assembly **5** is supported from the plate **4** by a pair of vertically extending shanks **11**. Assembly **5** includes a plurality of fork arms **6**, five fork arms being shown, which are mounted in transversely spaced and parallel relation to each other to provide longitudinally extending openings in which material to be engaged can be located. The facing sides of the fork arms are equipped with clamping members **7** which are adapted to secure the material to be conveyed, as will be described below.

Clamping members **7** are spaced equally apart over the length of each fork arm, and are connected by common pressure conduit means **8** of a closed pressure system which may be filled, for example, with either hydraulic or pneumatic fluid or with a mechanical pressure transmission means such as steel balls. The closed pressure system is equipped with piston members **9** which are connected to a carrier plate **10** overlying each fork arm **6** and parallel to it. Carrier plates **10** preferably extend over the entire length of the respective fork arms **6**, as show in FIGURES 1 and 2.

In each of two vertical shanks **11** which are connected to the fork conveyor assembly **5** and which support the latter from transverse plate **4**, there is provided a pressure reservoir (FIG. 5) comprising a spring operated plunger **12** having a sealing ring **13** associated therewith, and an adjusting nut **14** providing pre-load pressure on the plunger through a spring **15**. The system, hydraulic as shown, is filled by removing nut **14** and plunger **12** and then filling the pressure system **8** with a hydraulic fluid. In frigid areas glycerin may be used as a pressure transmission medium to withstand relatively extreme

degrees of cold. If the attachment is to be equipped with a pneumatic medium it is expedient to provide in the area of hollow space **16** below the plunger **12** a connector, not shown, for receiving compressed air or the like.

As illustrated in FIGURE 3, the clamping members **7** are located in cylindrical spaces **17** which are connected with the pressure system **8**. Each of the clamp members is equipped at its outer end with a clamp jaw **18** which preferably has a serrated surface **19**. An annular packing **20** is located at the inner end of each clamp member **7**. A collar **21** of each clamp member abuts one end of a return spring **22** which is provided between the inside wall of space **17** and the clamp member **7**. Each spring **22** at its opposite end is supported by a nut **24** which is threaded into each fork arm **6** flush with the latter's outer surface **23**.

In FIGURE 4 is shown the relationship of one of pressure pistons **9**, which is secured to carrier plate **10** as by welding, to the system **8**. Piston **9** is located in a cylindrical space **25** which is connected with pressure system **8**, and at the upper end of piston **9** is attached the carrier plate **10**. A circular packing **26** surrounds the lower end of piston **9**. A compression spring **27** is located between each carrier plate and its fork arm **6** which serves as a return spring in a manner to be described. Preferably a stop member **28** is located on each fork arm to provide a pressure limiting means for the respective piston **9**. The stops may, of course, be adjustable within the fork arm to provide for variations in the length of stroke of pistons **9**.

Referring now especially to FIGURE 8, the operation of the above embodiment will be described. The material to be conveyed as, for example, tiles, bricks or blocks **29**, is arranged in a well-known manner so that the fork assembly **5** with its fork arms **6** can be driven in the direction indicated by arrow *a* (FIG. 1) into hollow spaces **30** which are located between rows formed in the bottom layer of such material so that the fork arms may assume the position shown in FIGURE 2 with respect to the lowermost row of the stack of material. The adjacent or second layer and succeeding layers of such material **29** are stacked solidly upon the lower rows thereof without providing spaces such as indicated at numeral **30**, whereby the location of fork assembly **5** as shown in FIGURE 2 causes carrier plates **10** to be situated directly beneath the second layer or the stack of bricks or other material, as shown in FIGURE 1.

As hoist motor **1***a* is energized to raise the unit in lifting mast **1** carrier plates **10** first come to bear on the undersides of the second layer of material and, because of the weight of the material, they are caused to move relative to fork arms **6** in the direction indicated by arrow *b* which causes pistons **9** to apply pressure to the fluid in system **8**, thereby transmitting clamping pressure against piston surface **31** of collar **21** of the clamping member **7** so that the clamping members are pressed against the material in a direction indicated by arrow *c*. In order to adjust the clamping pressure to the nature of the bricks or other material and to preclude damage to the clamping members or material by excessive pressures, adjusting nuts **14** of the reservoir **11** may be adjusted, and pressure limiters **28** also adjusted, if necessary, to limit the available stroke of pistons **9**.

Thus, the clamping of the material by member **7** is accomplished advantageously prior to lifting of the material by the fork assembly **5**. This is in contrast to prior known structures for a similar purpose wherein pumps and the like have been provided for the purpose of supplying pressure fluid to clamp members which engage the bricks or other material. It will be apparent that the present invention insures that the material is not lifted until sufficient clamping pressure is provided to insure secure gripping thereof. This avoids both a possible loss of the load and any relative movement between the clamp member ends **18** and the load which would lead to undue wear of the clamp members and to undesirable abrasion of the bricks or other material. Of course, other forms of the clamping members **7** can be provided than that shown. For example, instead of using jaws **18** it may be found desirable to utilize a hardened steel ball secured to clamp member **7** and usable with extremely hard bricks, for example, so that the surface thereof will not be damaged by the serration of the clamping jaws.

When the material conveyed is to be deposited, pistons **9** are restored to initial position by springs **27**, the fork arm **6** having been lowered so that the lowest row of bricks rests on the ground and carrier plates **10** are lowered out of contact with the second layer of bricks. The pressure of the medium in system **8** is thereby released and clamp members **7** are thereupon restored to initial position by return springs **22**. Return springs **22** can be omitted in many instances inasmuch as a vacuum tends to be developed within system **8** coincident with upward movement of pistons **9** relative to fork arms **6** in the direction indicated by arrow *d*, which allows clamp member **7** to return in the direction of arrow *e* to the starting position thereof. Thus, the clamp jaws are actuated away from the bricks and the fork assembly can then be moved by the lift truck in the direction indicated by arrow *f* (FIGURE 1) out of the brick stack.

A second embodiment of the invention is illustrated in FIGURES 6, 7 and 9, wherein an annular chamber **33** is located between each collar **21** and clamp jaw **18** in fork arm **6** and communicates with a passage **34** which is filled with the pressure transmission medium. Passage **34** connects each annular chamber **33** with a chamber **35** formed between a piston rod **36** of a return piston **37** and the inner wall of a cylindrical space **38**. Piston rod **36** is joined with carrier plate **10** as by welding. Each return piston **37** is provided with a circular packing member **39** and is sealed with respect to fork arm **6** by packing means **40** and **41** which are located in position by a nut **42**. A vent **44** to atmosphere is provided in the space beneath piston **37**. The annular chamber **33** is sealed by a flat sealing member **45** which is held in position by a nut **47** furnished with a ring packing **46**.

Clamping of the bricks or other material is accomplished in essentially the same manner as described earlier in respect of FIGURES 3, 4 and 8. The return movement of each clamp member **7** to starting position for releasing each fork arm **6** from the stack of material after depositing same takes place in the independent upward movement of each piston **9** which is raised by spring **27**, such spring action simultaneously causing upward movement of return pistons **37** which releases the pressure in conduit **34** permitting inward movement of clamping member **7**. In order always to be able to adjust the manner of operation of the return piston **37** to the manner of operation of the fork assembly, a pressure reservoir **48** is provided, schematically illustrated in FIGURE 9, which is designed in the same manner as reservoir **11**.

Now, while I have shown and described only two embodiments of the present invention, it will be understood that various rearrangements and modifications may be made therein without departing from the spirit and scope of my invention.

I claim:

1. A device usable with lift trucks and the like for engaging, transporting and depositing material such as bricks, tile, blocks or the like, comprising a pair of fork arms supported from the truck and extending forwardly thereof in parallel spaced relation, a plurality of pairs of opposed reciprocable clamping members mounted inside the fork arms and extending outwardly thereof into the space formed therebetween, a common fluid pressure transmitting medium interconnecting all of said clamping members in each fork arm, and a fluid presusre producing means mounted inside the fork arms for generating fluid

pressure in the pressure transmitting medium upon lifting movement of the fork arms to support a load, said fluid pressure producing means being the sole means associated with the device for generating fluid pressure in said pressure transmission medium, said generated fluid pressure transmitting through said common fluid pressure transmitting medium forces causing all of said clamping members in each fork arm to be actuated toward each other into the space between the fork arms.

2. A device for handling material such as bricks, tile, blocks or the like, comprising a pair of longitudinally extending and transversely spaced parallel arm members, movable clamping means extending inwardly into the space between the arm members in opposed facing relation, a plurality of fluid pressure producing means associated with each arm member operatively connected to the clamping means, said operative connection including a common fluid conduit means conducting a fluid pressure transmitting medium between the clamping means and the plurality of pressure producing means in each arm member, said fluid pressure producing means being activated upon lifting movement of the arm members to forcefully engage a load to pressurize the medium in the common fluid conduit whereby to simultaneously actuate the opposed clamping means in opposite directions into the space between the arm members, a fluid reservoir connected to the fluid conduit means, and means in said reservoir for producing an initial pressure level in the pressure transmitting medium.

3. A device as claimed in claim 2 wherein other fluid means are associated with the clamping means and with the pressure producing means for actuating same to an initial non-clamping position upon movement of the arm members downwardly to disengage the load.

4. A clamping fork arm assembly usable with industrial trucks and the like for engaging, transporting and depositing material such as bricks, tile, blocks or the like, comprising a plurality of arm members mounted for lifting movement on the truck and extending forwardly thereof in parallel spaced relation, a plurality of opposed clamp members mounted in the sides of said arm members and extending inwardly into the space formed between each pair of arm members, a closed common fluid

circuit containing a pressure producing fluid and contained within the fork arm assembly interconnecting said clamp members, pressure producing means in said fluid circuit associated with each arm member and connected to the pressure producing fluid including means overlying each arm member adapted upon lifting movement thereof to contact the underside of a load to be conveyed, engagement with said load causing the pressure producing means to be actuated downwardly relative to said arm members transmitting through the fluid a force which acuates simultaneously by way of the common fluid circuit and at a common fluid pressure the clamp means into the space formed between the respective clamping arms to forcefully engage opposite sides of rows of a lowermost tier of the load located in the spaces formed between the arm members.

5. A device as claimed in claim 4 wherein manually adjustable piston means is provided for producing an initial pressure in the fluid prior to engagement of the pressure producing means with a load.

6. A device as claimed in claim 4 wherein said pressure producing means includes piston means connected to the member overlying each arm member, and other piston means connected to the member overlying each arm member and by means of the fluid in the system to the clamping members for restoring the clamping members to initial non-clamping position upon lowering movement of the pressure producing means out of engagement with a load.

7. A device as claimed in claim 6 wherein manually adjustable piston means is also provided for producing an initial pressure in the fluid prior to engagement of the pressure producing means with a load.

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