

March 3, 1970

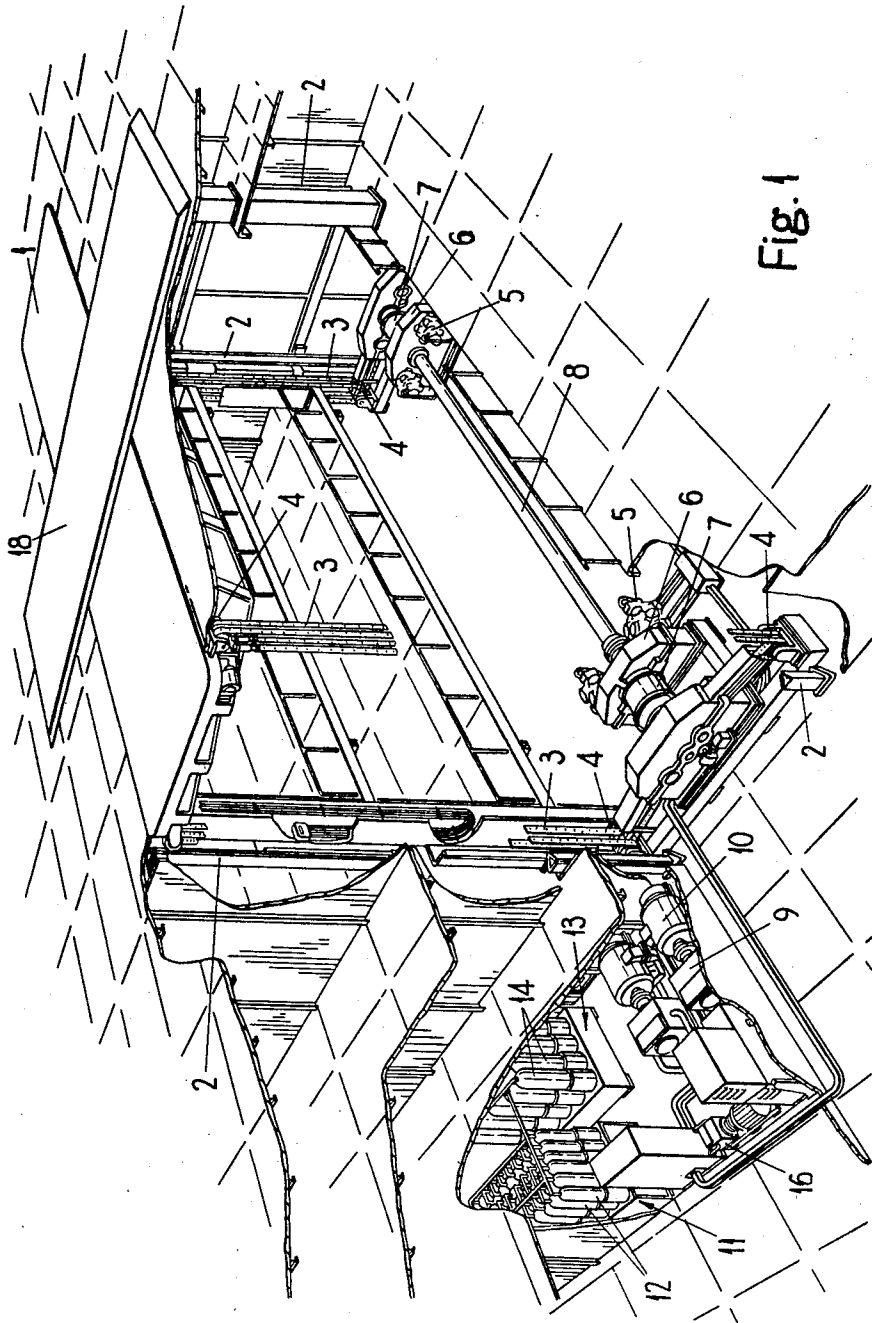
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3,498,415

LIFTS

Filed Jan. 24, 1968

3 Sheets-Sheet 1



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LIFTS

Filed Jan. 24, 1968

3 Sheets-Sheet 2

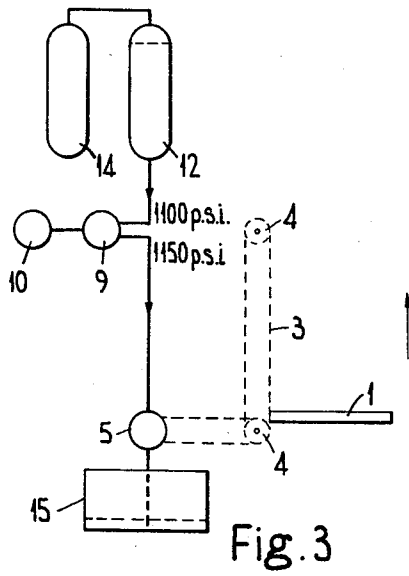


Fig. 3

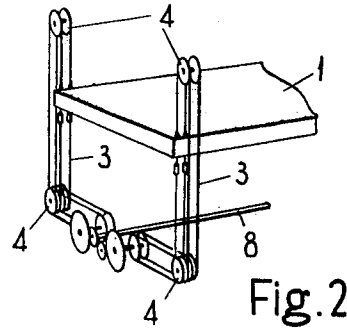


Fig. 2

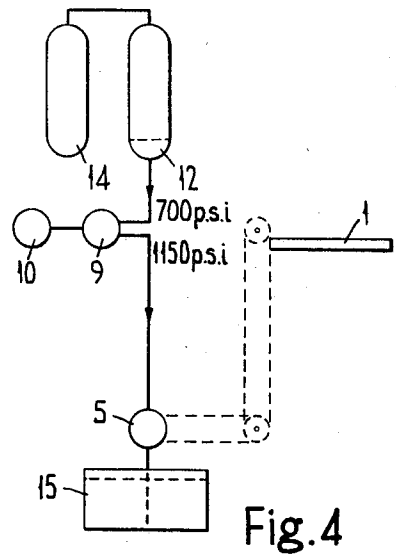


Fig. 4

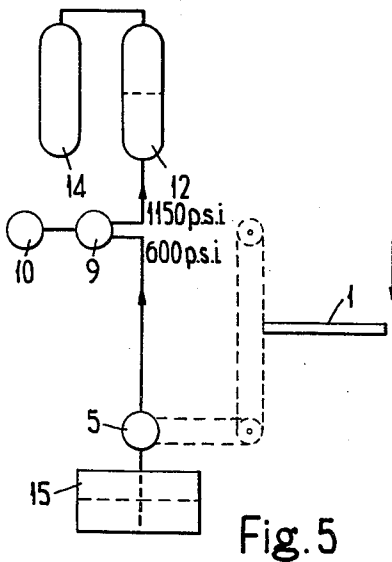


Fig. 5

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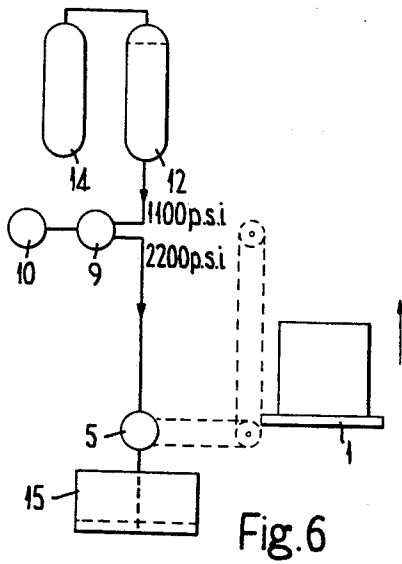
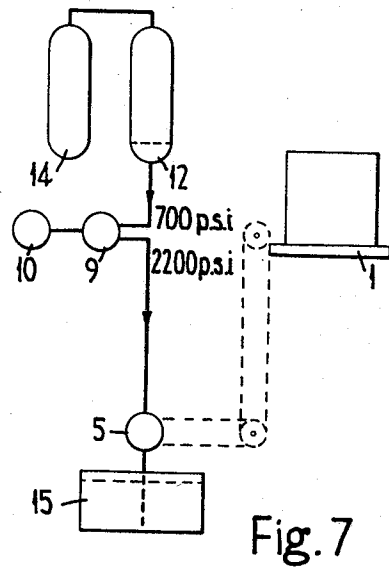
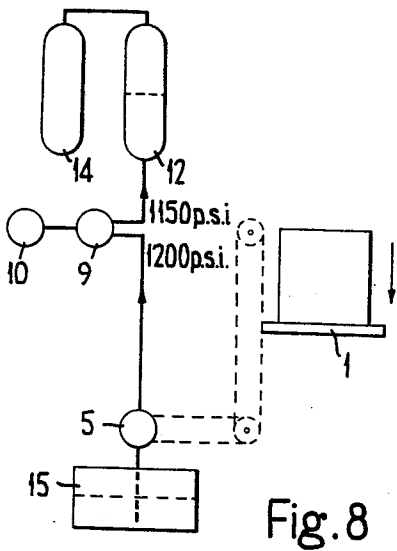
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Filed Jan. 24, 1968

3 Sheets-Sheet 3



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Filed Jan. 24, 1968, Ser. No. 700,306

Claims priority, application Great Britain, Jan. 24, 1967, 3,586/67

Int. Cl. B66b 9/04

U.S. Cl. 187—17

6 Claims

ABSTRACT OF THE DISCLOSURE

A driving arrangement for a lift, especially of the kind used on board ship for transporting articles of cargo or the like to various deck levels, including a hydraulic motor unit controlling the movement of the lift platform, and balancing means in the form of a hydraulic accumulator supplying fluid under pressure to the pump means feeding the motor unit.

This invention relates to lifts, and especially to lifts of the kind designed for use on board ship, for example to transport articles of cargo or the like to various deck levels served by the lift in order to facilitate loading and unloading. The invention is more particularly concerned with driving arrangements for lifts of this kind, and an object of the invention is to provide a particularly advantageous form of lift driving arrangement for use with such lift systems.

According to the invention a lift driving arrangement for a lift platform supported for vertical movement between a plurality of levels, includes a hydraulic motor unit for raising the lift platform, and reversible pump means for supplying fluid under pressure to drive the motor unit, the arrangement including also storage means for the fluid supplied to the motor unit and a hydraulic accumulator for supplying fluid under pressure to the inlet side of the pump means when the latter is operated to feed the motor unit, which fluid is fed back to the accumulator from the storage means when the lift platform is lowered, the relationship between the total volume and fluid capacity of the accumulator being such that the pressure of the fluid at said pump inlet, when the lift platform is in its highest position, is a substantial proportion of the pressure at said pump inlet when the lift platform is in its lowest position.

The accumulator acts, in effect, as a balance for the lift platform, and by constructing the accumulator in a manner such that there is a substantial pressure of fluid at the pump inlet when the lift platform is fully raised, an appreciable degree of balance is achieved over the whole range of movement of the platform, thereby reducing the power requirements needed for driving the lift.

Moreover such an arrangement has the advantage that the balance can be achieved with an additional weight which is less than that of existing arrangements designed to give the same degree of balance.

In addition the pump means and accumulator system may be located at positions remote from the hydraulic motor unit, if desired, thereby enabling the lift well and its immediate vicinity to be kept clear of all but the necessary platform lifting equipment. More than one hydraulic motor unit suitably coupled together may be employed for operating the lift platform if desired.

The pump means, which may be provided by one or a plurality of individual pumps, is conveniently driven by one or more electric motors, the pump or pumps conveniently being of the variable delivery kind having a controllable swash-plate which can be adjusted to provide the

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reverse pumping action. The electric motor or motors can then be of the constant speed type rotatable in one direction. However other means of obtaining the reverse feed of the fluid for driving the hydraulic motor unit or units in opposite directions to effect the raising and lowering of the lift platform can be employed if desired.

The accumulator conveniently consists of a plurality of cylinders having their lower ends connected to the pump means, and of sufficient combined capacity to contain the hydraulic fluid required to be accommodated by the accumulator when the lift platform is in its lowest position, the tops of the cylinders being connected to further cylinders designed to contain gas, for example air or nitrogen, under pressure, the total volume of the further cylinders being at least equal to and preferably being greater than that of the fluid cylinders. The relationship between the volume of the gas cylinders and that of the fluid cylinders is preferably such that the hydraulic fluid pressure at the pump inlet when the lift platform is in its highest position is at least 60% of that at the pump inlet when the lift platform is in its lowest position.

The actual pressures employed will, of course, depend upon the particular lift system in which the invention is to be used and upon the loads which the lift is designed to carry, the most suitable pressures for any particular application of the invention, however, being readily ascertainable by calculation or trial.

In order that the invention may be more readily understood, and further features made apparent, a lift system incorporating a driving arrangement in accordance with the invention and designed for moving articles of cargo and the like between different deck levels of a ship will now be described by way of example with reference to FIGURES 1 to 8 of the accompanying schematic drawing.

In the drawing FIGURE 1 represents a perspective view of the installed lift system,

FIGURE 2 represents a diagrammatic view of the lifting arrangement employed, and

FIGURES 3 to 8 illustrate various stages in the operation of the driving and balancing arrangements.

Referring to the FIGURES 1 and 2 of the drawing, the lift system comprises a rectangular lift platform 1 movable vertically in guides 2 between different decks of the ship. The lift platform is supported at each corner by chains 3 which pass over sprockets 4 at the top and bottom of the lift well, the lower sprockets being driven, for raising and lowering the lift by hydraulic motor units 5 through reduction gearing 6, brakes 7 being provided for holding the lift platform securely in any set position. Separate hydraulic motor units are used for driving the chains at opposite ends of the lift, but the output shafts are coupled by means of a common synchronising shaft 8.

The hydraulic system for driving the motor units 5 comprises main variable delivery pumps 9 for supplying fluid to the units, and driven themselves by electric motors 10; also included is a hydraulic accumulator 11, consisting of a plurality of vertical cylinders 12 providing an oil reservoir and having their lower ends connected to the system through a common feed pipe, the upper ends of the cylinders being connected to a pressurised gas reservoir 13 which also consists, for convenience, of a plurality of vertical gas cylinders 14 containing, for example, compressed air or nitrogen at a suitably high pressure. The total internal volume of the cylinders 14 which provide the pressurised gas reservoir is greater than that of the cylinders 12 forming the oil reservoir.

In order to raise the lift platform 1, oil is pumped from the cylinders 12 of the accumulator by the main pumps 9, through the motor units 5 and into a storage tank 15 (FIGURE 3), lowering of the lift platform causing

oil to be fed back into the accumulator, a make up pump 16 being provided to compensate for losses in the main pumps 9.

It will be seen that the hydraulic accumulator, provided by the oil and pressurised gas cylinders, acts as a balancing arrangement for the lift system; the total volume of the gas cylinders in relation to that of the oil cylinders and the pressure of the gas is such that with the lift in its lowest position and the oil cylinders containing the maximum quantity of oil, the pressure of the oil at the inlet side of the pumps 9 is approximately 1100 p.s.i. and with the lift raised to its highest position the pressure is approximately 700 p.s.i.

Thus the accumulator assists in supporting the lift platform over its whole range of movement, thereby reducing the power requirements of the motors driving the main pumps 9.

This is shown more clearly by reference to FIGURES 3 to 8; thus referring to FIGURE 3, the lift platform 1 is shown at the lowest position of its range of travel, the oil reservoir cylinder 12 of the hydraulic accumulator being substantially full of oil and the oil pressure on the inlet side of the pumps 9 being 1100 p.s.i. as previously explained. With the lift platform empty as shown the pressure of oil required to be supplied to the hydraulic motor units 5 to raise the platform is 1150 p.s.i., the motors 10 being required to supply additional power to the system equivalent to, say, 15 H.P.

As the oil from the reservoir cylinders is discharged there will be a fall in pressure on the inlet side of the pumps 9, and the additional power supplied by the motors 10 will need to be increased, FIGURE 4 showing the platform approaching its highest position with the oil pressure on the inlet side of the pump of the order of 700 p.s.i. and the additional power then required to be supplied by the motors being, say 180 H.P., although it will be observed that since there is still a considerable pressure at the inlet side of the pumps 9 the power requirements of the motors 10 are reduced over the whole range of movement of the lift.

FIGURE 5 shows the empty platform being lowered, the hydraulic motor units 5 acting as pumps, and the direction of feed of the main pumps 9 being reversed, so that the hydraulic accumulator is being recharged. The pressure at which is now the pump inlet is for example 600 p.s.i. and with the outlet pressure required to change the accumulator of the order of 1150 p.s.i., the motors are required to supply additional power of, say, 70 H.P.

FIGURES 6 to 8 illustrate the lift in positions corresponding to those shown in FIGURES 3 to 5 but with the lift platform fully loaded.

Thus in FIGURE 6, the lift platform 1 is shown at the bottom of its range of travel and requiring an oil pressure at the hydraulic motor units 5 of, say, 2200 p.s.i. to raise the lift. The pressure at the pump inlet, with the lift platform in this position and the accumulator fully charged, is 1100 p.s.i. and additional power required to be supplied by the motors 10 is, say, 460 H.P.

In FIGURE 7 the lift platform 1 is shown approaching its highest position the pressure at the pump inlet having fallen to 700 p.s.i. and the additional power then required to be supplied by the motors 10 being 600 H.P.

When the fully loaded lift is being lowered the pressure at what is now the pump inlet is, say, 1200 p.s.i. which is greater than that required to recharge the accumulator, the main pumps then acting as motors and driving the motors 10, thus enabling power to be fed back into the supply if required.

It will be appreciated that the above values of pressure and horsepower are given by way of example only and the actual values will depend upon the particular lift installation with which the invention is designed to be employed and the purposes for which the system is intended to be used.

The power units provided by the main pumps 9, the motors therefor and the accumulator cylinders 12, 14 are shown in FIGURE 1, installed in a power room adjoining the lift well, but it will be appreciated that the power room can be placed at a position remote from the well if this is convenient. In addition the oil and gas cylinders may be located at positions remote from the pump and motors, and also from each other if desired, which is particularly advantageous for ship-board installations where space requirements are often stringent.

The lift platform is conveniently provided as shown in FIGURE 1 with a turntable support 18, so that goods loaded on to it, for example at the upper deck, can readily be fed into any desired storage position at the lower deck levels by rotation of the turntable into appropriate positions.

However it will be appreciated that although the invention is mainly applicable to lift systems designed for ship-board use, it may also be used to advantage in lift systems designed for other purposes, where the total weight and power requirements of the system are required to be kept as small as practicable.

I claim:

1. A lift driving arrangement for a lift platform supported for vertical movement between a plurality of levels, including at least one rotary hydraulic motor unit for raising the lift platform, and reversible pump means for supplying fluid under pressure to drive the motor unit, the arrangement including also storage means for the fluid supplied to the motor unit, a gas pressure hydraulic accumulator connected to the inlet side of the pump means so as to supply fluid under pressure thereto when the latter is operated to feed the motor unit, and means for feeding fluid back to the accumulator from the storage means when the lift platform is lowered, the relationship between the total volume and fluid capacity of the accumulator being such that the pressure of the fluid at said pump inlet, when the lift platform is in its highest position, is a substantial proportion of the pressure at said pump inlet when the lift platform is in its lowest position.

2. A lift driving arrangement according to claim 1, wherein the accumulator consists of a plurality of cylinders having their lower ends connected to the pump means, and of sufficient combined capacity to contain the hydraulic fluid required to be accommodated by the accumulator when the lift platform is in its lowest position, the tops of the cylinders being connected to further cylinders designed to contain gas under pressure, the total volume of the further cylinders being at least equal to and preferably being greater than that of the fluid cylinders.

3. A lift driving arrangement according to claim 2, wherein the said gas consists of compressed air or nitrogen.

4. A lift driving arrangement according to claim 2, wherein the relationship between the volume of the gas cylinders and that of the fluid cylinders is such that the hydraulic fluid pressure at the pump inlet when the lift platform is in its highest position is at least 60% of that at the pump inlet when the lift platform is in its lowest position.

5. A ship-board lift installation comprising a lift platform for transporting articles of cargo or the like between different deck levels, at least one hydraulic motor unit coupled to means for raising and lowering the lift platform, pump means for supplying fluid under pressure to drive the motor unit so as to effect the raising of the lift platform, storage means for the fluid supplied to the motor unit by the pump means, a gas pressure hydraulic accumulator connected to the inlet side of the pump so as to supply fluid under pressure thereto when the latter is operated to feed the motor unit, and means whereby the fluid is fed back from the storage means to the accumulator through the pump means when the lift platform is lowered, the relationship between the total volume and

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fluid capacity of the accumulator being such that the pressure of the fluid at said pump inlet, when the lift platform is in its highest position, is a substantial proportion of the pressure at said pump inlet when the lift platform is in its lowest position.

6. A ship-board lift installation comprising a lift platform for transporting articles of cargo or the like between different deck levels, at least one hydraulic motor unit coupled to means for raising and lowering the lift platform, pump means for supplying fluid under pressure to drive the motor unit so as to effect the raising of the lift platform, storage means for the fluid supplied to the motor unit by the pump means, a gas pressure hydraulic accumulator connected to the inlet side of the pump so as to supply fluid under pressure thereto when the latter is operated to feed the motor unit, and means whereby the fluid is fed back from the storage means to the accumulator through the pump means when the lift platform is lowered, the accumulator consisting of a plurality of cylinders having their lower ends connected to the pump means, and of sufficient combined capacity to contain the hydraulic fluid required to be accommodated by the accumulator when the lift platform is in its lowest position, the tops of the cylinders being connected to further cylinders designed to contain gas under pressure,

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the total volume of the further cylinders being at least equal to and preferably being greater than that of the fluid cylinders and being such that the pressure of the fluid at said pump inlet, when the lift platform is in its highest position, is a substantial proportion of the pressure at said pump inlet which the lift platform is in its lowest position.

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U.S. Cl. X.R.

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