

Sept. 26, 1944.

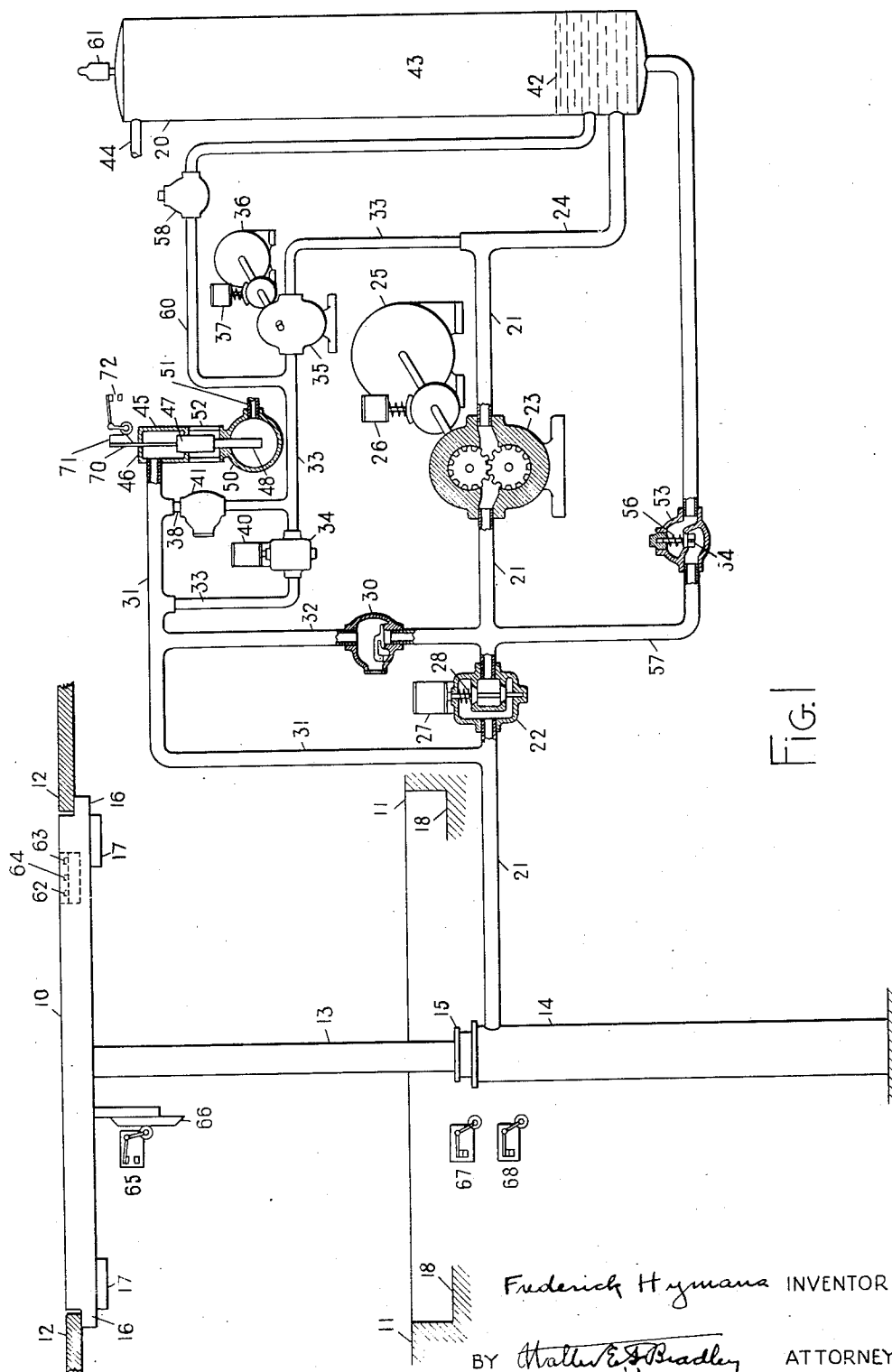
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2,359,112

HYDRAULIC ELEVATOR

Filed Aug. 14, 1943

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2 Sheets-Sheet 2

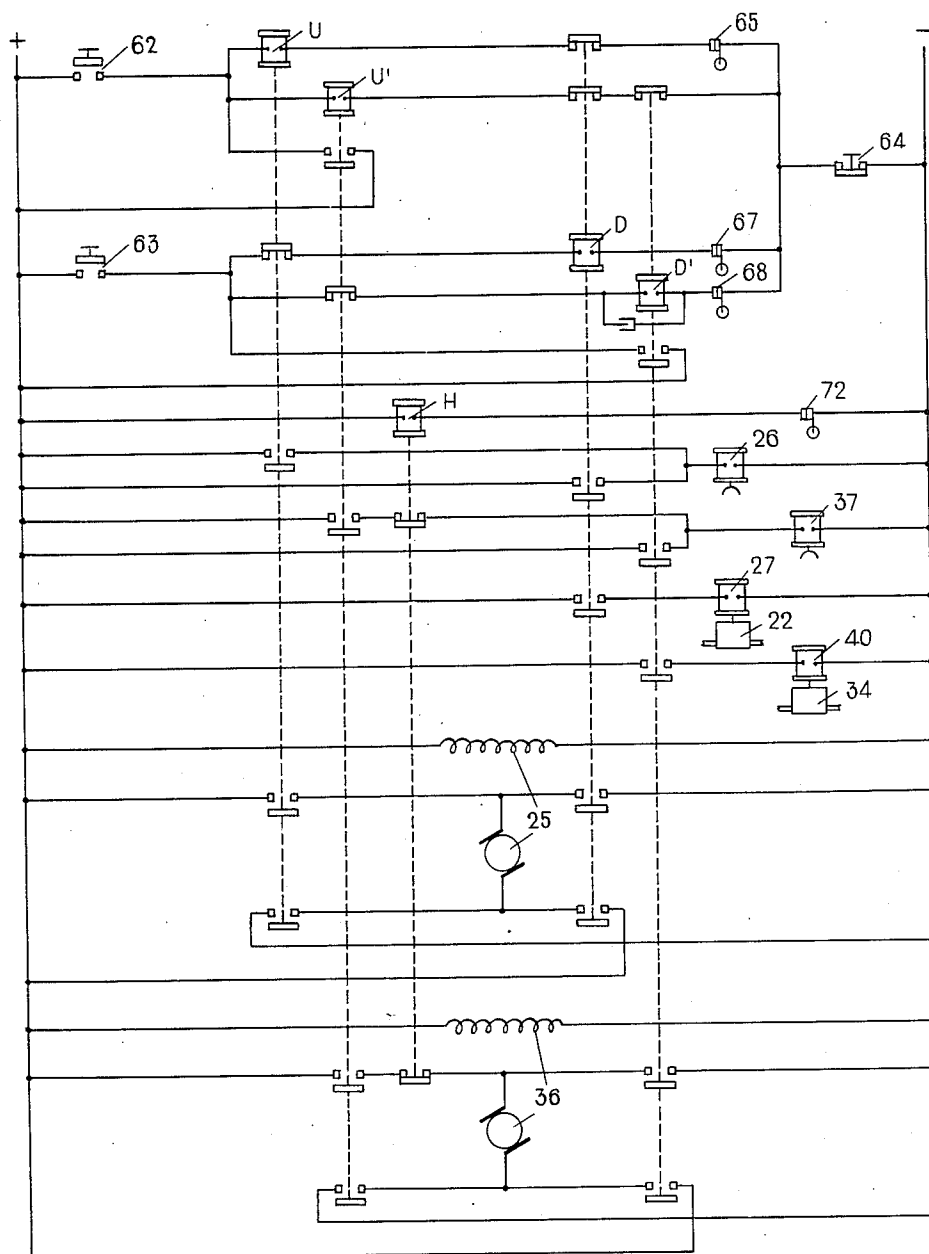


FIG. 2

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2,359,112

HYDRAULIC ELEVATOR

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Application August 14, 1943, Serial No. 498,904

6 Claims. (Cl. 187—28)

The invention relates to hydraulic elevators.

There are certain advantages in hydraulic elevators, especially for low rise installations. Such elevators are particularly suitable for installation on ships and in certain categories are required. In certain type ships such as naval vessels, counterweights for the cars are not permitted, thereby adding to the power required to operate the elevator. For exceptionally heavy duties on ships of this character, as for example elevators for carrying airplanes on airplane carriers, the power required to operate the elevator is considerable. Also, speed of operation is important so that it is desirable to operate the car at a fast speed between the transfer decks and at a slow speed preparatory to stopping the car. Furthermore, it is important that the car platform be kept level with the transfer decks in order that the transfer of the planes may be readily made and, in the case of the upper transfer or flight deck, in the event that an airplane should land on this deck.

It is the principal object of the invention to provide a hydraulic elevator in which the car may be operated at a fast speed between landings and at a slow speed as it approaches the landing at which a stop is to be made, in which the car platform is maintained level with the landings when stopped and in which the power required to operate the elevator is minimized.

In carrying out the invention, according to the embodiment which will be described, a hydraulic counterpoise is provided for the elevator car in the form of a tank containing fluid under pressure. Pumps are provided between the tank and the lifting cylinder for effecting fluid transfer therebetween. One of these pumps is of relatively small capacity and is utilized for operating the elevator car at a slow speed preparatory to stopping. The invention will be described as applied to an installation in which the elevator platform is utilized to transfer airplanes between a hangar deck and a flight deck. To maintain the platform level with the flight deck an accumulator is employed in conjunction with the small pump to hold the platform against stops associated with the flight deck.

Features and advantages of the invention will be apparent from the above statements, the description which follows and appended claims.

In the drawings:

Figure 1 is a diagrammatic representation of a hydraulic elevator installation embodying the invention; and

Figure 2 is a schematic wiring diagram of a

simple electrical control system for the elevator, illustrating interconnections for the various elevator control devices.

Referring first to Figure 1, the elevator installation illustrated is one in which the elevator platform 10 is utilized to carry airplanes from the hangar deck 11 of an airplane carrier to the flight deck 12 and to return them from the flight deck to the hangar deck. Also the elevator is illustrated as of the plunger type. The plunger 13 is secured at the top to the platform 10 from which it extends downwardly into the cylinder 14 through a stuffing box 15. Extensions 16 are provided on the platform for engaging the bottom of the flight deck which forms stops to align the platform with the flight deck. Pads 17 are provided on the bottom of the platform which engage stops 18 below the level of the hangar deck to align the platform with the hangar deck.

Cylinder 14 is connected to a reservoir 20. One connecting path is by way of pipe 21 through a poppet valve 22 and the main pump 23 to another pipe 24 connected to tank 20 near the bottom thereof. The pump is illustrated as a gear pump driven by an electric motor 25 and provided with an electromechanical brake 26 for bringing the pump to a stop. The poppet valve is illustrated as of the balanced pressure type, operated by an electromagnet 27 and biased to closed position by a spring 28. The poppet valve is bypassed by a check valve 30 by way of pipes 31 and 32. The check valve is illustrated as of the hinged type.

Another connecting path between the cylinder and the reservoir is by way of pipes 21, 31 and 33 through a poppet valve 34 and auxiliary pump 35 to pipe 24. Pump 35 may also be a gear pump driven by an electric motor 36 and provided with an electromechanical brake 37. The poppet valve may be of the same type as valve 22, its operating electromagnet being designated 40. It also is by-passed, the by-pass being by way of pipe 38 through a check valve 41 which may be of the hinged type.

The reservoir 20 is illustrated as in the form of a vertical tank, partially filled with liquid 42, such as oil, for operating the elevator. Above the liquid level is air 43 under pressure. The pipe 44 indicates a source of air supply for providing the desired pressure in the tank.

The pipe 31 is connected to an accumulator 45. This accumulator is illustrated as in the form of a cylinder 46 to which pipe 31 is connected and having a plunger 47 operating therein. The end

48 of the plunger is of reduced diameter and forms another plunger extending into an air reservoir 50. This reservoir contains air under pressure. The pipe 51 indicates a source of air supply for providing the desired pressure in reservoir 50. The cylinder 48 and reservoir 50 are secured in fixed relationship by members 52 extending between them. It is to be understood that the cylinder and reservoir are provided with suitable stuffing boxes, not shown.

The main pump 23 is provided with a relief valve 53. This valve is illustrated as in the form of a valve member 54 biased to closed position by a spring 55. The valve is illustrated as arranged in a pipe 57 connecting pipe 21 adjacent the main pump to reservoir 20 at the bottom thereof. A similar relief valve 58 is provided for auxiliary pump 35 and is arranged in a pipe 60 connecting pipe 33 adjacent the auxiliary pump to the reservoir 20 at the bottom thereof. Instead of extending to the reservoir, pipes 57 and 60 may discharge into open tanks. A relief valve 61 is provided for reservoir 20.

Referring now also to Figure 2, push buttons are illustrated for exercising manual control of the operation of the elevator. These push buttons are arranged in the elevator platform and beneath the platform surface. Three buttons are illustrated, one designated 62 for causing up car travel, another designated 63 for causing down car travel and a third designated 64 for stopping the platform at any point. Slowing down of the elevator as it nears the flight deck is effected by means of a switch 65 operated by a cam 66 carried by the platform. A similar switch 67 is operated by the cam to slow down the platform as it nears the hangar deck. Cam 66 operates a second switch 68 as the platform reaches the hangar deck to stop the platform. A stem 70 extends upwardly from plunger 47 and has a cam 71 on the upper end thereof for operating a switch 72 to stop the auxiliary pump 35 when sufficient oil has been forced into cylinder 48 to move plunger 47 downwardly far enough for cam 71 to operate switch 72.

Assume that the platform is at the hangar deck and that it is desired to raise it to the flight deck. The up button 62 is pressed. This button acts through electromagnetic switch U to cause energization of the release coil for the electromechanical brake 26 to release the brake and to cause current to be supplied to motor 25 for rotation counterclockwise, as viewed in Figure 1. This causes operation of the main pump to force oil by way of pipe 21, pipe 32 through check valve 30, pipe 31, and thence again to pipe 21 and into cylinder 14. This forces plunger 13 upwardly to raise platform 10. It will be assumed that as illustrated in the wiring diagram the control is arranged so that button 62 also acts through electromagnetic switch U' to cause energization of the release coil of brake 37 and to cause current to be supplied to motor 36 to operate auxiliary pump 35 to force oil by way of pipe 33, pipe 38 through check valve 41, pipe 31 and pipe 21 into cylinder 14. Thus under this assumption the auxiliary pump assists the main pump in raising the platform.

As the platform arrives at a certain distance from the flight deck, cam 66 opens switch 65. This breaks the circuit for the coil of switch U to cause deenergization of motor 25 and brake 26 to stop the main pump. The auxiliary pump 35, however, operates to supply oil in reduced volume to the cylinder. As a result the platform is slowed

down to a low speed determined by the capacity of the auxiliary pump.

As the platform reaches the level of the flight deck its extensions 18 engage the bottom of the flight deck to bring the platform to a stop. The auxiliary pump continues in operation, however, supplying oil to the cylinder 48 of the accumulator. The oil thus supplied forces plunger 47 outwardly from the cylinder and thus plunger 48 farther into reservoir 50 against the existing air pressure. When the accumulator plunger 47 has been moved outwardly a certain amount so that a considerable quantity of oil has accumulated in cylinder 48, cam 71 causes opening of switch 72 to break the circuit for the coil of switch H to cause deenergization of motor 36 and the release coil of brake 37 to bring the auxiliary motor to a stop. The air pressure in reservoir 50 is sufficient to maintain enough pressure in cylinder 14 to hold the platform against the flight deck even when a plane lands on the platform. This is the condition of the system as illustrated in Figure 1. As leakage of oil takes place in the main cylinder 14 plunger 47 is forced back into cylinder 48 by the air pressure in reservoir 50, causing the reclosing of switch 72. This reestablishes the circuit for the coil of switch H which operates to restart the auxiliary pump. This renews the oil in the accumulator, and this operation is repeated so long as the platform remains at the flight deck, thereby assuring the platform being maintained level with the flight deck at all times.

To lower the platform, down button 63 is pressed. This completes the circuit for the coil of switch D which operates to cause release of electromechanical brake 26 and to cause current to be supplied to motor 25 for rotation clockwise as viewed in Figure 1. At the same time switch D causes energization of operating magnet 27 of poppet valve 22 to open this valve. The main pump being rotated in a direction to return oil to reservoir 20, oil flows from cylinder 14 by way of pipe 21, through poppet valve 22 (check valve 30 preventing the flow of oil by way of pipe 32), pipe 24 to the bottom of reservoir 20. Assuming that, as illustrated in Figure 2, down button 63 also causes operation of switch D', brake 37 is released and motor 36 is energized for clockwise rotation, so that oil also flows by way of pipe 31 through poppet valve 34, opened as the result of the energization of its operating electromagnet 40 along with energization of motor 36, to the reservoir.

As the platform nears the hangar deck, cam 66 opens switch 67 which breaks the circuit for the coil of switch D, deenergizing electromagnet 27, motor 25 and the release coil for brake 26. Thus the main pump is stopped and poppet valve 22 is closed. The auxiliary pump continues in operation, however, so that oil is returned in reduced volume from the cylinder to the reservoir 20. This slows down the platform to a low speed. Just before the pads 17 engage stops 19, cam 66 opens switch 68 which breaks the circuit for the coil of switch D', deenergizing motor 36 and the release coil of brake 37 and the brake is applied to bring the auxiliary pump to a stop. At the same time poppet valve 34 closes. It is to be understood that sufficient timing is provided, as by providing a condenser in parallel to the coil of switch D' to delay the dropping out of electromagnetic switching mechanism controlled by switch 68, to enable the continued operation of the auxiliary pump sufficient to

bring pads 17 against the stops and thus align the platform with the hangar deck.

Pressure of the air in reservoir 20 is such that the pressure exerted by the oil in cylinder 14 is somewhat less than the weight of plunger 13 and unloaded platform 10 and apparatus carried thereby. When the pumps are rotated to raise the platform they act to build up the pressure to a point sufficient to effect this operation. The capacity of the reservoir is such that the volume of air is large as compared with the change in the volume of oil in moving the platform from one deck to another. Thus the variation in pressure in the reservoir in effecting such movement is not very great. The pressure in the reservoir may, therefore, be considered as a hydraulic counterpoise and the power of the pump driving motors need only be sufficient for handling the net load.

In lowering the platform, inasmuch as the pressure under the plunger is greater than that in the reservoir, the pumps serve to regulate the speed of descent. Since the speed of the elevator platform is in proportion to the speed of the pump driving motors there will be very little variation in the speed with or without load for each direction of travel.

The check valves 30 and 41 act to prevent oil returning from the cylinder to the reservoir by way of the pumps when the pumps are stopped. The relief valves 53 and 58 open in case of abnormal pressure. If, for example, a pump should continue in operation to pump oil from the reservoir and thus build up pressure after the control mechanism has acted to cause it to stop, its relief valve opens when the pressure reaches a certain point. Also should a pump be operated with a shut-off valve (not shown) on the cylinder side of the pump closed, its relief valve opens to relieve the pressure.

While described as applied to an elevator utilized for raising and lowering airplanes it is to be understood that the invention may be applied to other types of elevator installations. Also the invention may be applied to other types of hydraulic lifting mechanism, as for example horizontal hydraulic engines with roping. While only two landings are illustrated, it is to be understood that the elevator may be arranged to serve more than two landings. Pumps of types other than gear pumps may be utilized for effecting the transfer of oil from and to the reservoir. Two or more main pumps in parallel lines may be utilized instead of the single pump illustrated in which event it would be preferred to have separate driving motors and brakes for each pump with separate electromagnetic control switches therefor. In such an arrangement these pumps could be cut off one at a time to slow down the platform in steps. Variations may be made in the construction of valves illustrated, it being understood that the valves shown are diagrammatic and are for the purpose of illustrating the operation.

The accumulator 45 is an important feature of the invention, especially for airplane elevators on carriers where it is important that the platform be kept level with the flight deck and maintained so even under conditions where a plane should alight on the platform. However, the construction of the accumulator may be varied, it being understood that the arrangement shown is diagrammatic and for the purpose of illustrating the operation of the invention.

As many changes could be made in the above

construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An airplane transporting elevator for an airplane carrier comprising; a platform serving a flight deck and a hangar deck; a plunger extending downwardly from the platform; a cylinder for said plunger; a reservoir containing oil and air under pressure above the oil; main pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; auxiliary pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; means for causing operation of said pumping mechanisms to transfer oil from the reservoir to said cylinder to raise said platform; means operable as the platform nears the flight deck to cause stopping of the main pumping mechanism to slow down the platform; and means for stopping the platform when it becomes level with the flight deck.

2. An airplane transporting elevator for an airplane carrier comprising; a platform serving a flight deck and a hangar deck; a plunger extending downwardly from the platform; a cylinder for said plunger; a reservoir containing oil and air under pressure above the oil; main pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; auxiliary pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; means for causing operation of said pumping mechanisms to transfer oil from the reservoir to said cylinder to raise said platform; means operable as the platform nears the flight deck to cause stopping of the main pumping mechanism to slow down the platform; means for stopping the platform when it becomes level with the flight deck; an accumulator having a chamber connected to said cylinder for storing oil under pressure upon operation of the auxiliary pumping mechanism after the platform has stopped; and means responsive to the volume of oil in said chamber to cause stopping of the auxiliary pumping mechanism when said oil in the chamber reaches a certain volume and to cause restarting of the auxiliary pumping mechanism when said oil in said chamber decreases to below said certain volume.

3. An airplane transporting elevator for an airplane carrier comprising; a platform serving a flight deck and a hangar deck; a plunger extending downwardly from the platform; a cylinder for said plunger; a reservoir containing oil and air under pressure above the oil; main pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; auxiliary pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; means for causing operation of said pumping mechanisms to transfer oil from the reservoir to said cylinder to raise said platform; means operable as the platform nears the flight deck to cause stopping of the main pumping mechanism to slow down the platform; means for stopping the platform when it becomes level with the flight deck; an accumulator having an oil chamber connected to said cylinder and adapted in conjunction with said auxiliary pumping mechanism to maintain sufficient oil pressure in said

cylinder to hold said platform level with the flight deck, said accumulator also having an air chamber containing air under pressure against which oil is forced into said oil chamber; and means operable when the accumulator has received a certain amount of oil to cause stopping of the auxiliary pumping mechanism and also operable when the amount of oil in the accumulator has decreased a certain amount to restart the auxiliary pumping mechanism.

4. An airplane transporting elevator for an airplane carrier comprising; a platform serving a flight deck and a hangar deck; a plunger extending downwardly from the platform; a cylinder for said plunger; a reservoir containing oil and air under pressure above the oil; main pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; auxiliary pumping mechanism connected on one side to said cylinder and on the other side to said reservoir; means for causing operation of said pumping mechanisms to transfer oil from the reservoir to said cylinder to raise said platform; means operable as the platform nears the flight deck to cause stopping of the main pumping mechanism to slow down the platform; means for stopping the platform when it becomes level with the flight deck; an accumulator having an oil chamber connected to said cylinder and adapted in conjunction with said auxiliary pumping mechanism to maintain sufficient oil pressure in said cylinder to hold said platform level with the flight deck, said accumulator also having an air chamber containing air under pressure against which oil is forced into said oil chamber; means operable when the accumulator has received a certain amount of oil to cause stopping of the auxiliary pumping mechanism and also operable when the amount of oil in the accumulator has decreased a certain amount to restart the auxiliary pumping mechanism; means for causing operation of said pumping mechanisms to transfer oil from the cylinder to said reservoir to lower said platform; means operable as the platform nears the hangar deck to cause stopping of the main pumping mechanism to slow down the platform; and means operable as the platform arrives at the hangar deck to cause stopping of the auxiliary pumping mechanism to stop the platform.

5. An airplane transporting elevator for an airplane carrier comprising; a platform serving a flight deck and a hangar deck; a plunger extending downwardly from the platform; a cylinder for said plunger; a reservoir containing oil and air under pressure above the oil; oil conducting means between said cylinder and said reservoir; additional oil conducting means between said cylinder and said reservoir; a main pump in the first named conducting means; an auxiliary pump in said additional conducting means; valve means for said main pump in said first named conducting means between the pump and the cylinder; valve means for said auxiliary pump in said additional conducting means between the pump and the cylinder; means for causing operation of said pumps to transfer oil from the reservoir to said cylinder to raise said platform; means operable as the platform nears the flight deck to cause stopping of the main pump to slow down the platform; means for stopping the platform when it becomes level with the flight deck; an accumulator connected to said cylinder and auxiliary pump for building up the pressure of

the oil in said cylinder under operation of the auxiliary pump after the platform has stopped; means operable when the accumulator has acquired a certain amount of oil to cause stopping of the auxiliary pump and also operable when the amount of oil in the accumulator has decreased a certain amount to restart the auxiliary pump; means for causing operation of said pumps to transfer oil from the cylinder to said reservoir to lower said platform; means operable as the platform nears the hangar deck to cause stopping of the main pump to slow down the platform; and means operable as the platform arrives at the hangar deck to cause stopping of the auxiliary pump to stop the platform.

6. An airplane transporting elevator for an airplane carrier comprising; a platform serving a flight deck and a hangar deck; a plunger extending downwardly from the platform; a cylinder for said plunger; a reservoir containing a certain percentage by volume of oil and a larger percentage by volume of air under pressure above the oil; a main pump; a pipe line connecting one side of the pump to said cylinder and the other side of the pump to the oil containing portion of said reservoir; a poppet valve in said pipe line between the main pump and the cylinder; a by-pass for the poppet valve, said by-pass including a check valve biased to prevent the flow of oil therethrough from the cylinder to the pump; an auxiliary pump; a pipe line connecting one side of the auxiliary pump to said cylinder and the other side to the oil containing portion of said reservoir; a poppet valve in the last named pipe line between the auxiliary pump and the cylinder; a by-pass for the last named poppet valve, said by-pass including a check valve biased to prevent the flow of oil therethrough from the cylinder to the pump; means for causing operation of said pumps to build up the pressure of oil in said cylinder and transfer oil from the reservoir through the check valves to said cylinder to raise said platform; means operable as the platform nears the flight deck to cause stopping of the main pump to slow down the platform; means for stopping the platform when it becomes level with the flight deck; an accumulator connected to said cylinder and auxiliary pump by the last named pipe line for building up the pressure of the oil in said cylinder under operation of the auxiliary pump after the platform has stopped; means operable when the accumulator has acquired a certain amount of oil to cause stopping of the auxiliary pump and also operable when the amount of oil in the accumulator has decreased a certain amount to restart the auxiliary pump; means for causing opening of said poppet valves and operation of said pumps to transfer oil from the cylinder through the poppet valves to said reservoir to lower said platform; means operable as the platform nears the hangar deck to cause stopping of the main pump to slow down the platform and closing of the first named poppet valve; means operable as the platform arrives at the hangar deck to cause stopping of the auxiliary pump to stop the platform and closing of the second named poppet valve; and a pair of relief valves, one for each pump, each relief valve being on the cylinder side of the pump for which it is provided.

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