Abstract

Apparatus for engaging a portion of a vehicle to lift the vehicle for servicing. The lift or jack includes a wheeled frame supporting a fluid powered actuator or motor adapted to actuate a hydraulic cylinder power unit to raise the load at a substantially constant rate. Mechanical linkage is provided to manually actuate the hydraulic cylinder to lift the load where a pressurized air supply is unavailable. A mechanical linkage including a pivotal lifting arm is operatively connected to the fluid powered hydraulic cylinder unit to lift a vehicle upon the preselected operational mode of said unit.

10 Claims, 7 Drawing Figures
VEHICLE SERVICE JACK

BACKGROUND OF THE INVENTION

This invention relates in general to vehicle lifting apparatus and, in particular, to an improved lifting jack operable manually, through a pressurized air supply, or both modes of operation simultaneously.

In the servicing of automotive vehicles, whether they are at a location such as an automotive repair garage or along a roadway, it is quite frequently necessary to elevate the vehicle in order to work on portions of the engine, power train, or undercarriage. The lifting jack which is operable by means of a source of pressurized air is much more convenient for a mechanic in that it permits him to elevate the vehicle with a minimum of manual labor; it is more time saving and provides a rapid lifting of the vehicle. In addition, the lifting jack which is operable by means of a pressurized air supply can be actuated from a remote location such that the mechanic can more closely inspect the car during the lifting process. However, the source of pressurized air is not always conveniently available in a repair garage and obviously is unavailable when servicing a vehicle on a roadway. Therefore, the lifting jack must be capable of elevating the vehicle through manual operation of a handle.

While in many applications the lifting jack can be operated manually to elevate a vehicle, it has been found in substantial number of instances, due to the space required to operate the handle, that the mechanical actuation of a jack is extremely time consuming and in some instances it is impossible to apply the lifting force in the exact position desired due to space restrictions which interfere with the arc of the handle movement. Therefore, the actuation of the jack through a pressurized air supply is very desirable.

In the instant invention, both modes of operation are combined such that the lifting jack may be operated manually or through a source of pressurized air and therefore the advantages of each system are combined into one device. In addition, to further increase the speed of operation the lifting jack may be operated through the application of pressurized air during actuation of the handle mechanism.

SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to improve lifting jacks.

Another object of this invention is to selectively actuate the lifting mechanism manually through the use of a hand operated hydraulic pump or by a pressurized air actuated fluid motor.

A further object of this invention is to provide an improved lifting mechanism for selective actuation of the lift through the use of a pressurized air fluid motor or manual operation.

Still another object of this invention is to actuate the lifting mechanism through the use of a hand operated hydraulic pump and a pressurized air actuated fluid motor simultaneously.

These and other objects are attained in accordance with the present invention wherein there is provided a lifting jack with a rigid frame or base having a plurality of rollers attached thereto for permitting the jack to be rolled upon a surface to any desired position beneath the vehicle. A lifting arm is pivotally connected to the frame or base and actuated by means of a hydraulic fluid cylinder selectively operated through the use of a fluid motor driven by a pressurized air supply or manually through operation of a handle mechanism.

DESCRIPTION OF THE DRAWINGS

Further objects of the invention, together with additional features contributing thereto and advantages accruing therefrom, will be apparent from the following description of one embodiment of the invention when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of the portable lifting jack;
FIG. 2 is a side elevation view of the lifting jack with portions removed to better illustrate the internal elements thereof;
FIG. 3 is a plan view of the lifting jack with portions broken away to better illustrate the internal structure thereof;
FIG. 4 is a detailed sectional view showing the hydraulic cylinder power unit used to raise the lift elements;
FIG. 5 is a detailed sectional view of the valve arrangement used in conjunction with the air motor;
FIG. 6 is a detailed sectional view of the air motor used to actuate the hydraulic cylinder; and
FIG. 7 is a sectional view of the hydraulic cylinder power unit of FIG. 4 taken along lines 7—7 and reduced in size.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, there is shown a portable lifting jack 100 including a lifting mechanism 20, a hydraulic power unit 30 for elevating the lifting elements, an air motor 60 and a mechanical linkage 40, for actuating the hydraulic pump thereby raising the lifting elements. The lifting mechanism 20 is pivotally supported between a pair of chassis side plates 1 and 2 which are preferably made from steel plate of appropriate thickness and held in parallel, spaced relationship with respect to each other by means of a forward spacer 3 and rearward spacer 4 secured to the side plate by any suitable means.

The forward portion of the chassis side plates 1 and 2 rotateably support an axle 6 to which is secured a pair of wheels 7 for moving the portable lift apparatus beneath a portion of a vehicle to be elevated. The wheels 7 are secured to axle 6 by means of retaining rings 8 in the conventional manner. Axle 6 is supported in the side chassis plates by conventional bearings. Brackets 9 are secured to the chassis side plates and each bracket carries a caster assembly 11 appropriately secured thereto to facilitate the positioning of the jack assembly beneath a vehicle. The brackets 9 space the caster assemblies 11 a sufficient distance from the side plates 1 and 2 to permit the caster roller to pivot completely about the connection point.

As best shown in FIGS. 2 and 3, the lift arm assembly 20 comprises a lift plate 21 having depending side portions 22 which extend in parallel, spaced relationship with respect to each other and are supported in the chassis side plate 1 and 2 for pivotal movement such that the depending side portions move in a plane parallel to that of the side plates. The lift arm assembly is supported between the chassis side plates 1 and 2 by
means of a tubular lift bearing assembly 23 which is secured between the side plate to permit the pivoting of the lift arm assembly thereabout. A portion of each depending side plate is fitted with an aperture which carries the tubular lift bearing assembly 23. The lift mechanism 20 is pivoted with respect to the side plates 1 and 2 to elevate a vehicle upon actuation of the hydraulic power unit 30. The depending side plates 22 are formed with apertures which support the bell crank shaft 28. The roll pin 29 mechanically secures a rod 31 of the hydraulic pump unit 30 to the lifting mechanism 20 such that upon extension of the rod 31 from the hydraulic pump unit the lifting mechanism 20, acting as a bell crank, will pivot upward effecting a lifting force.

A lift head or saddle 24 is carried by the lift arm assembly 20 and comprises a head platform 25 and a pair of parallel, platform support legs 26 depending therefrom and secured to opposed portions of the sides 22 of the lift arm 21 by a suitable bearing to allow the lift head to pivot relative to the lift arm assembly. The platform support legs 26 have a pair of aligned openings adjacent to their lower extremities to which a pair of head erecting parallel link bars 27 are pivotally connected. The opposite end of the head erecting bars 27 are each pivotally supported (12) to the chassis side plates 1 and 2 such that the lift head 24 will be continuously held erect throughout all positions of normal operation of the lift arm mechanism thereby maintaining the platform 25 in a continuous horizontal orientation. The movement of the head erecting bars 27 is parallel to the chassis side plates 1 and 2 and the path of the lift arm assembly 20 when actuated by means of the hydraulic power unit 30. A tension spring 13 is secured at one end to a connecting rod 14 (joining the pair of head erecting bars 27) and to the forward spacer rod 3 at its other end to provide a retreating force on the lift arm mechanism 20 to facilitate lowering of the lift mechanism after an elevated vehicle has been lowered to its original position.

The hydraulic power unit 30 is pivotally supported between the chassis side plates 1 and 2 by means of suitable bearings or bushings supported through the chassis side plates and engaging a portion of the hydraulic pump unit. Actuation of the hydraulic power unit is effected by means of either an air motor 60 or through a mechanical linkage assembly 40 which act to drive a piston carried within the hydraulic power unit effecting the extension of the connecting rod or plunger 31 which is coupled to the lift arm assembly 20. The reciprocating, hydraulic power unit is carried between the chassis side plates and operatively connected with the air motor 60 and mechanical linkage system as best shown in FIGS 4, 5 and 6.

The hydraulic power unit 30 (shown in sectional detail in FIG 4) includes a valve housing 110, secured to one end of a hydraulic cylinder 115 the other end of which is closed by a top cap 120 to form a sealed chamber. A hydraulic fluid reservoir 116 is formed between the outer wall of the hydraulic cylinder 115, the top cap 120 and valve housing 110 by a reservoir plate 117 forming a closed chamber with ports 118 which function in a manner to be hereinafter described. The hydraulic fluid reservoir is of a size sufficient to contain a quantity of hydraulic fluid for use in actuating the plunger rod 31 to effect elevation of the lifting mechanism 20.

Positioned within the hydraulic cylinder 115 is a plunger-piston assembly 130. The plunger rod 31, which is secured to the lift arm assembly 20, is formed with a reduced end portion 131 carrying a piston or plunger cup 140 and comprises an extension of the assembly 130.

The plunger cup 140 is utilized to effect a hydraulic seal on the plunger 31 and the resultant force is used to elevate the lifting mechanism 20. To that end, a support disc 141 is carried on the reduced end portion 131 of the plunger abutting the shoulder formed thereby. The plunger cup or piston 140 is supported by the disc with a suitable back-up washer 142 and held thereto by means of a nut and washer assembly 144 threaded onto the reduced end portion of the rod 131. The plunger-piston assembly 130 thereby forms a hydraulically sealed piston whose movement is dependent upon the hydraulic pressing forces exerted against the face of the plunger cup 140.

Positioned within the hydraulic chamber 150 is a high limit stop mechanism 170 which functions to prevent the hydraulic plunger-piston assembly 130 from being driven out of the chamber and thereby reduces the structural strength requirement of the top cap 120. The plunger rod 31 is formed with an orifice (176) passing through the reduced end portion (which carries the plunger cup 140) with the orifice forming a connecting fluid conduit from hydraulic chamber portions 150a to 150b by means of the fluid communication of the chamber 176 with a connecting conduit in which is supported a stop pin 171. The connecting conduit 176 is normally sealed to prevent hydraulic fluid flow therethrough by means of a ball check valve 173 in place by a spring 174 suitably positioned by a hollow retaining ring 175 threaded into the reduced end portion of the plunger 31. In operation, as the plunger is extended to the left at its furthermost position (FIG. 4), the stop rod 171 will engage the inner face 120a of the top cap moving the stop rod slightly to the right in the enlarged opening in which it is carried. This movement of the limit stop rod mechanically unseats the ball check valve 173 from its valve seat by means of the connecting linkage 172. The fluid in the chamber 150a is therefore metered through the conduit 176 at a controlled rate into the portion 150b of the hydraulic chamber. This metered flow of hydraulic fluid through the orifice connecting these two portions of the chamber prevents an excessive pressure build-up in chamber 150a which would tend to drive the piston-plunger assembly 130 out through the top cap 120, but maintains sufficient pressure to hold a vehicle in the lifted position. The fluid passing from chamber 150a to 150b passes out through the ports 118 into the intake tube 111 through the connecting conduit 113, all check valves 122 and 124, through conduit 123 and is returned to the portion 150a of the hydraulic cylinder chamber.

As previously stated, the hydraulic power unit 30 may be actuated by means of an air motor 60 or manually through pivotal movement of the handle 5 which is connected to a mechanical linkage assembly 40 to effect the desired lifting movement of the lift arm mechanism 20. The air motor 60 (shown in sectional detail in FIG. 6 of the drawings) is coupled to the hydraulic power unit 30 in a manner shown in FIG. 5. The air motor 60 is actuated to elevate the lifting mechanism by means of a pressurized air source supplied
through conduit (shown in FIG. 2 with the air line 61 and control valve 59 rotated 90° to better illustrate these elements).

The air motor 60 comprises a valve housing 62 with a cylindrical displacement chamber 64 extending from one end thereof. The chamber is formed by a cylindrical wall 66. Reciprocally received in this displacement chamber 64 is a piston 68. Piston 68 is provided with a suitable sealing ring or packing 69 to form a fluid-tight seal. As shown in FIG. 6, the sealing means is accomplished by a sealing ring confined in an annular groove and slidable coacts with the inner surface of wall 66. The piston 68 is biased toward the valve housing 62 by a compression spring 63 which is seated between the reverse face of the piston 68 and an end plate 81 secured to the cylinder wall 66.

A hydraulic pump assembly 85 is secured to the end plate 81 in fluid communication with the displacement chamber 64. A piston rod 84 is carried at one end by the piston 68 and is axially aligned with an internal chamber or bore formed in the plunger body 86 and appropriately sealed by an "O" ring to form a hydraulic or fluid-tight seal thereabout. The end of the plunger body 86 remote from the piston 84 is formed to threadingly engage a manifold 96 which is coupled to a suitable passage or port of the hydraulic power unit 30 such that actuation of the air motor 60 will result in the displacement of the plunger-piston assembly 130 of the hydraulic power unit as will be hereinafter described in detail.

The valve housing 62 of the air motor 60 is formed with a cylindrical chamber 70. Chamber 70 is enlarged at surface 71. Reciprocally received within the chamber 70 is poppet member 72 having a valve 74 at one end thereof and a piston portion 76 at the other end. The piston 76 has a first periphery 77 closely received by the inner surface of the chamber 70 and a second periphery 79 closely received by the surface 71. A differential pressure chamber 80 is thus formed between the walls of the chamber and the exterior walls of the piston. The stem portion of the poppet 72 reciprocally movable within these chambers is formed to receive a spring biased (75) rod 78 which acts to control the actuation of a ball check valve 92.

The end 60c of the valve housing removed from the cylinder 66 is formed with an air inlet 90 which is reduced at 92 to form a valve seat for a spring biased (93) ball check valve 94. As the rod 78 moves to the right (referring to FIG. 6) it unseats the ball 94 for a purpose to be hereinafter described. The poppet 72 carries an elastomeric grommet 73 which closes an opening 67 when the poppet 72 is moved to the right and opens the opening as the poppet moves to the left. Te grommet is elastomeric so as to reduce chattering and to absorb the shock of the piston operating in its cycle.

In operation, a source of pressurized air is supplied to the inlet 90 with the valve initially unseated. As the air bypasses check ball 94, it simultaneously enters passageways (not shown) which communicate with the differential pressure area 80 creating a resultant net force to the right (FIG. 6). The effect of this force is to move poppet 72 and the rod 78 to the right to thereby maintain the check ball 94 away from its valve seat 92. During this same interval, air is delivered to the expansion chamber 64 which moves the piston 68 to the left.

When piston ring 69 passes servo-valve port 57 in chamber 66, air is conducted to chamber 71 through passages (not shown) creating the differential pressure needed to drive poppet 72 to the left. This opens valve opening 67 and allows rod 78 to move to the left. Spring 93 and air line pressure closes ball check valve 92. In order to prevent poppet 72 from attaining a balanced or hydraulic dead center position with the valve opening 67 being open and the inlet valve 92 being open, the spring 75 biases the poppet away from ball check valve 92 which is, therefore, closed by the biasing action of spring 93.

As grommet 73 is moved to the left, the air within the expansion chamber 70 is permitted to escape through an outlet not shown. Since the ball 94 is seated, incoming air is stopped during the exhaust of the air from chamber 70 through the outlet. With the decay of air pressure in chamber 70, the biasing spring 63 returns the piston 68 toward the valve housing 62. As the piston 68 approaches the poppet, the ball 94 is again moved from the seat 92 by rod 78 and the cycle again repeated.

The cyclic operation of the air motor reciprocates piston 68 back and forth in the displacement chamber 64 thereby reciprocating the piston 84 of the hydraulic plunger assembly 85 and creating a force on the plunger-piston assembly 130 of the hydraulic power unit 30 extending the plunger 31 affecting a lifting movement of the lift arm mechanism 20.

As previously discussed, the air motor 60 is actuated through a source of pressurized air 61 controlled by a valve 59 secured to the handle 5. A source of air pressure (not shown) is coupled to the valve 59 and upon actuation of the lever 58 the pressurized air flows through the supply line 61 into the fluid motor to effect reciprocation of the piston 68 and, thereby, the plunger 84 actuating the hydraulic power unit 30 elevating the lift mechanism 20.

Referring again to the hydraulic power unit 30, reciprocation of the plunger 84 of the air motor 60 withdraws hydraulic fluid from the hydraulic fluid reservoir 116 through the intake tube 111 as the plunger is withdrawn toward the right (as seen in FIG. 5) thereby unseating the ball check valve 112 from its valve seat thereby drawing the hydraulic fluid through fluid conduit 113. Upon reciprocation of the air motor, the plunger 84 is moved to the left and the valve 112 is again seated and ball check valve 114 is opened to allow the hydraulic fluid to be conveyed into portion 150a of the hydraulic chamber 150 via passage not shown moving the piston-plunger assembly to the left as shown in FIG. 4 for raising the lifting mechanism 20. As the actuation of the air motor 60 is repeated, hydraulic fluid is continually withdrawn from the fluid reservoir 116, or the portion 150b of the hydraulic chamber 150, and passed into the portion 150a of the chamber 150 affecting movement of the piston-plunger assembly 130 to the left.

As stated, the hydraulic power unit 30 may be actuated by manual manipulation of a pivotal lever or handle 5. To this end, a pump cylinder 160 is secured into the valve housing 110. The pump cylinder includes a speed pump plunger 162 slidably carried within the pump cylinder and mechanically coupled to the linkage mechanism 40. The speed pump plunger 162 is concentrically positioned about a power pump plunger 164 secured into the valve housing 110 and having a passage way defined therethrough in fluid communication with...
the passageways 113 and 213 (FIGS. 4 and 7) at a point between the ball check valves 122-124 and 222-224. Suitable seals and packings such as O-rings provide a fluid-tight seal between the plunger 162 and the power pump plunger 164. Due to the positioning of the valves in the housing 110, valves and ports 122, 124 and 113 are shown in FIG. 4 only and valves and ports 222, 224 and 213 are shown in FIG. 7 only.

As the plunger 162 is moved outwardly (referring to FIG. 4) by means of the mechanical linkage system, the plunger withdraws liquid from the hydraulic reservoir 116 and the area 150b of the hydraulic chamber through the intake tube 111, passageways 113 and 213, unseating the ball check valves 122 and 222, and withdrawing the hydraulic fluid into the passageway 163 and the internal bore portion of the plunger. At this time, ball check valves 124 and 224 are drawn downward against their respective valve seats. Upon the plunger 162 being operated in the reverse direction (to the left as shown in FIG. 4) the ball check valves 122 and 222 are firmly seated against their valve seat and the hydraulic fluid in the passageway 163 is passed through ball check valves 124 and 224, which are lifted from their valve seats, through passageways 123 and 256 into the chamber 150a of the hydraulic chamber 150. As the plunger 162 is cyclically operated, additional quantities of hydraulic fluid are passed in this manner resulting in the piston plunger assembly 130 moving outwardly to the left raising the lifting elements or mechanism 20.

The hydraulic fluid continues to be passed through this dual conduit (123,256) system into the chamber 150a until the pressure reaches approximately 200 psi. This dual conduit flow raises the lifting elements very quickly until the load or vehicle is engaged creating the pressure rise.

Upon the pressure increasing, pressure relief valve 180 is actuated, dumping the fluid heretofore passing through ball check valve 224 and conduit 256, through conduits 182 and 183 back into the reservoir 116 thereby decreasing the force required to operate the plunger 162.

The plunger 162 is connected to the mechanical linkage system 40 for effecting reciprocation thereof. A handle 5 extends from a yoke 41 which is pivotally secured between frame plates 1 and 2 by any suitable means such as shaft 42. The yoke 41 is linked to and coacts with segment 44 mounted on shaft 42 between the outer ends of the yoke 41. The pivotal lever arm or segment 44 is formed with a bifurcated portion such that each portion of the bifurcated segment is appropriately connected to a power link bar 45 extending from each of the bifurcated segments and pinned at the opposite end to the end of the plunger 162. Movement of the handle 5 causes the yoke 41 to move the power link 45 to reciprocate the plunger 162 of the pump cylinder 160 thereby effecting lifting of the lift mechanism 20. A suitable stop 43 is provided to limit the travel arc of the handle.

After the lift mechanism 20 has been elevated raising the vehicle or load, when it is desired to return the load to its initial position and remove the jack, the release assembly 50 is actuated by rotating knob 51 positioned at the top of the handle 5. Rotation of knob 51 rotates a rod 52 passing through the center of the handle 5 and connected to a pivot or universal assembly 53 to effect rotational movement of release valve link 54 coupled to the release valve plunger 55. Movement of the release valve plunger 55 outward (as seen in FIG. 4) unseats a ball check valve 56 from its valve seat allowing the force of the vehicle acting on the lift arm mechanism 20 to be transmitted through the plunger 31 to the hydraulic chamber 150b where the hydraulic fluid in chamber 150a is forced out through port 123 seating ball check valve 124 tightly against its valve seat and passing out through suitable passageways in the valve housing 110 to be returned to the hydraulic fluid reservoir 116. In this manner, whether the hydraulic power unit is actuated by the air motor 60 or manually through operation of the pump cylinder 160, release of the load is effected by unseating ball check valve 156 from its valve seat within the valve housing 110. The unseating of this ball check valve allows the hydraulic fluid to return through passages (not shown) to the hydraulic fluid reservoir 116. When the load has been returned to its initial stable position, the action of the tension spring 13 provides a sufficient load to fully retract the lift mechanism 20 and move the plunger-piston assembly 130 to the right as shown in FIG. 4.

While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that this invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A vehicle service jack comprising a frame having spaced side plates carrying a pair of rotatable wheels at one end thereof and a handle assembly at the opposite end, a pair of caster rollers supported by and spaced from said frame by bracket means secured to said side plates such that said caster rollers are freely pivotal about said bracket means, a lift mechanism pivotally secured to said side plates between said wheels and said caster rollers, hydraulic pump means coupled to said lift mechanism for effecting a pivotal lifting movement thereof upon the actuation of said pump means, an air motor carried between said side plates and adapted to be connected to a source of pressurized air, said air motor being operatively connected to said hydraulic pump means for actuating said pump means upon introduction of pressurized air to said motor, and linkage means carried between said side plates and connecting said handle assembly and said hydraulic pump means such that movement of said handle assembly actuates said pump means to effect pivotal lifting of said lift mechanism.

2. The apparatus of claim 1 further including valve means selectively operable to actuate said hydraulic pump means upon actuation of said air motor and said linkage means separately or simultaneously.
3. The apparatus of claim 1 further including release means carried by said hydraulic pump means for pivotally retracting said lift mechanism.

4. The apparatus of claim 1 wherein said lift mechanism comprises a lift plate having depending side portions connected to a portion of the hydraulic pump means to form a bell crank mechanism for elevating a vehicle.

5. The apparatus of claim 4 wherein said lift mechanism further includes a lift platform and a pair of head erecting bars supported at one end from said frame side plates and connected at the opposite end to said lift platform for maintaining said platform in a horizontal position throughout the pivoted movement of said lift mechanism.

6. The apparatus of claim 1 further including spring means coupled to said lift mechanism and said frame to effect a retracting force on said lift mechanism in a direction opposite to the pivotal lifting mechanism thereof.

7. The apparatus of claim 1 wherein said hydraulic pump unit is carried by said frame between said side plates.

8. The apparatus of claim 7 wherein said hydraulic pump unit is pivotally supported from said side plates.

9. The apparatus of claim 1 wherein said air motor is supported from said hydraulic pump unit.

10. The apparatus of claim 1 wherein said hydraulic pump unit includes a pump cylinder assembly actuable solely by said linkage means to effect pivoted lifting of said lift mechanism.

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