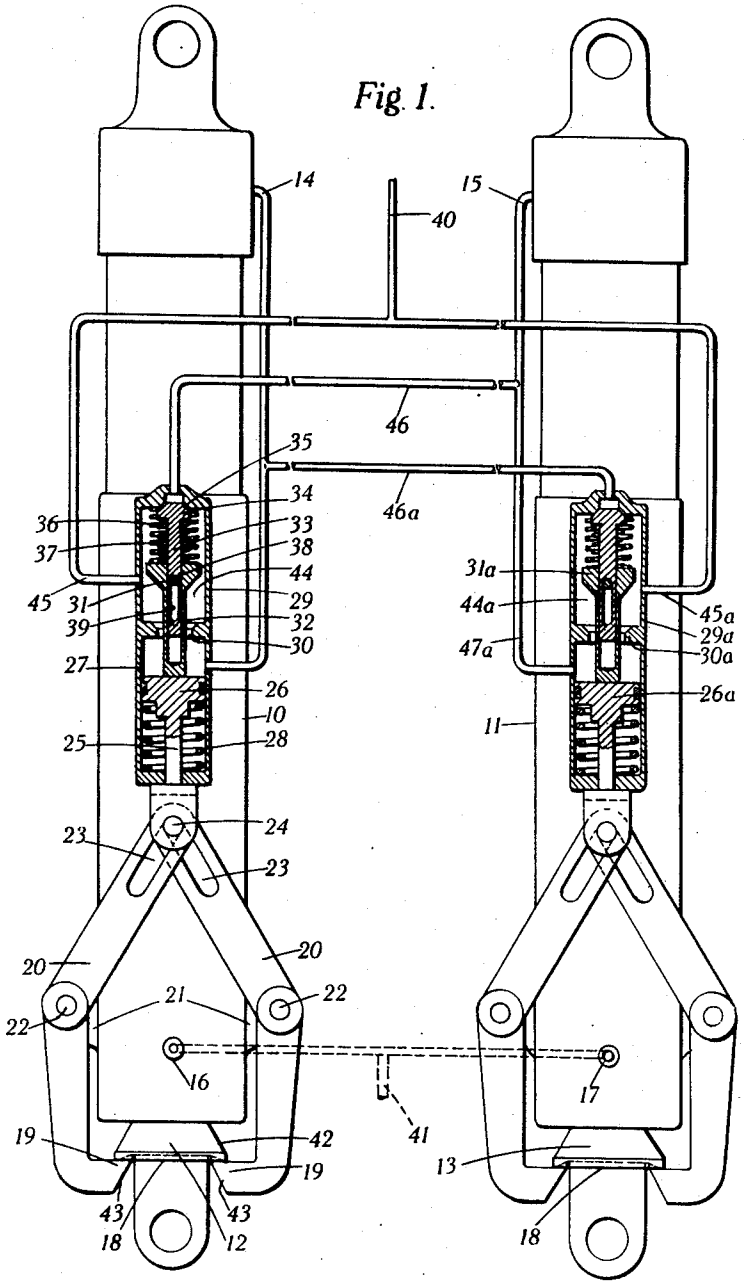
Jan. 24, 1939. S. M. PARKER 2,144,893

FLUID PRESSURE OPERATED JACK

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Fig. 1.



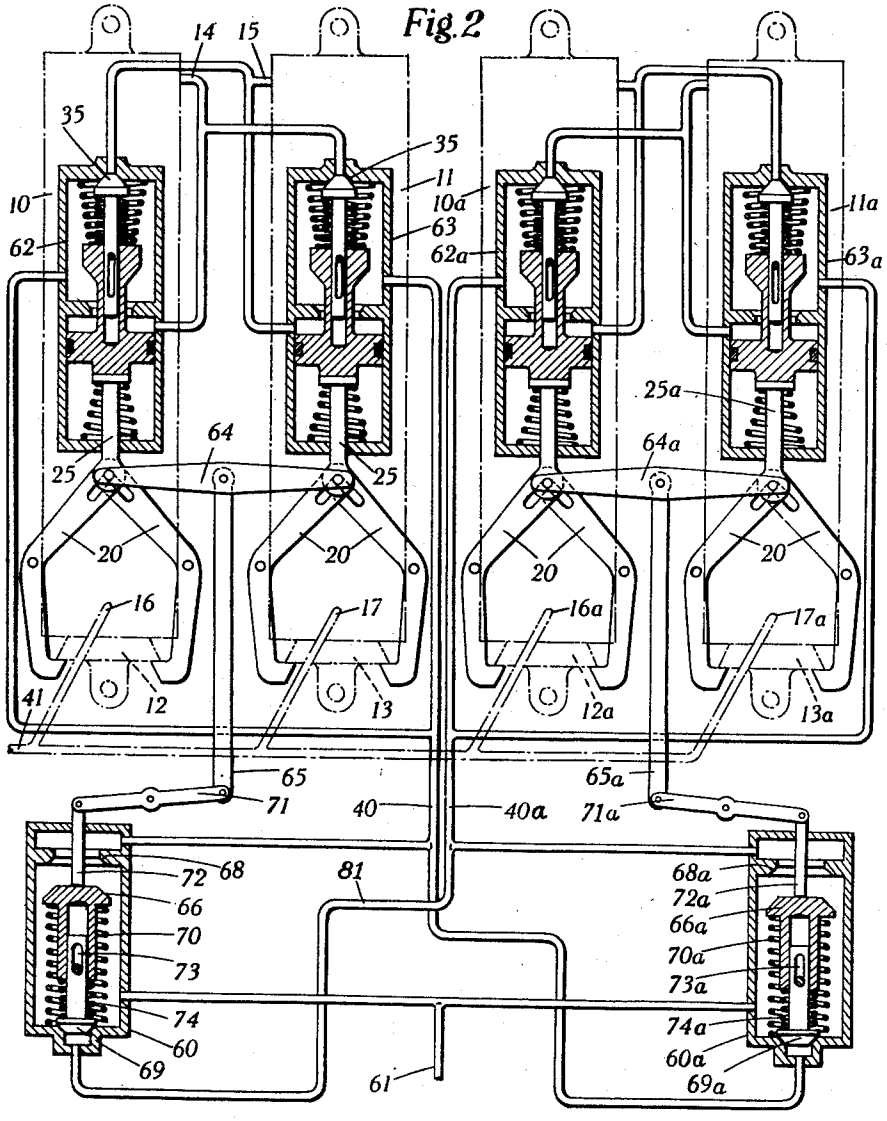

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FLUID PRESSURE OPERATED JACK

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Fig. 2




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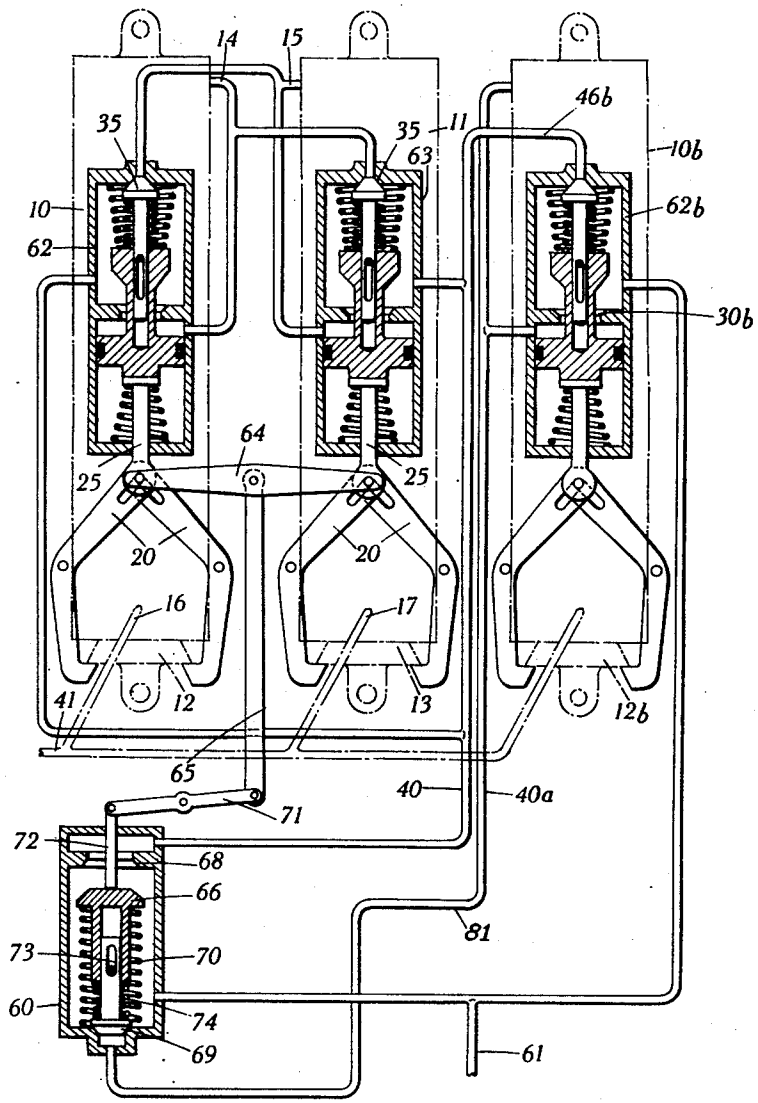
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FLUID PRESSURE OPERATED JACK

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*Fig. 3*




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# UNITED STATES PATENT OFFICE

2,144,893

## FLUID PRESSURE OPERATED JACK

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Application May 17, 1938, Serial No. 208,474
In Great Britain November 11, 1936

3 Claims. (Cl. 121—40)

The invention relates to fluid pressure actuated jacks, adapted to be used for operating retractable undercarriages, bomb release gear of aircraft and the like, and provided with locking mechanism acting to retain the jack in either or both of its extreme positions.

An object of the invention is to provide a system which will prevent any one of a series of such fluid pressure actuated jacks from operating until all of the series are unlocked. The risk of distorting or jamming the undercarriage in the event of one of the locking means being stiffer than the other of others, is thus avoided.

In the system herein disclosed the lock controlling means is embodied in a fluid actuated system comprising one or more pairs of jacks to be operated in unison from a common source of fluid pressure, each fitted with locking means released by the said pressure, and including a change-over valve device actuated by the respective locking means to prevent any jack from being operated until all locking means are released, each of said change-over valve devices having a main pipe connection fed with pressure fluid from the source and being adapted to lead fluid from this main connection to the corresponding lock-releasing means when the locking means is in action, or to the working space of another jack when the said locking means is released.

Other objects and features of the invention and other novel combinations of parts and desirable particular constructions will be apparent from the following description and from the accompanying drawings, in which

Figure 1 is a diagram indicating a general arrangement that may be used in applying the present invention to a single set of jacks having fluid actuated locking devices;

Figure 2 is a diagram indicating a general arrangement used for inter-connecting two sets of jacks having fluid actuated locking devices; and

Figure 3 is a diagram showing a method of interlocking three jacks.

In the example shown in Figure 1 a pair of jack units 10 and 11, such for example as are commonly employed for operating a retractable aircraft undercarriage, are arranged side by side, and have plunger members 12 and 13 respectively adapted to be forced down by fluid pressure introduced through pipe connections 14 and 15 in order to extend the jack and to move upwardly by passing fluid under pressure through the connections 16 and 17 when the jack is required to be contracted or shortened.

In order that the jacks may be positively held in their fully closed condition each of the plungers 12 and 13 is formed with a flange 18 which is adapted to be engaged by the turned in extremities 19 of a pair of locking levers 20, these being pivoted upon lugs 21 as indicated at 22. At its upper end each of the levers 20 is formed with a slot 23, and these are connected by a sliding pin 24 with a rod 25 secured to a piston 26 disposed within a hydraulic cylinder 27. A spring 28 normally urges the piston 26 in an upward direction and consequently causes the levers 20 to lock the plunger 12 mechanically when it is disposed in its uppermost position.

The cylinder 27 is extended to form the casing of a valve device 29 having a fixed seating 30, which is engaged by the head 31 of a mushroom valve element when the piston 26 is moved to its lowermost position during the process of releasing the locking levers 20, the stem 32 of said valve element being adapted to engage the piston 26. The valve element 31, 32 is hollow and is arranged to accommodate slidably the stem 33 of a second mushroom valve element having a head portion 34 adapted to engage a fixed seating 35 by the action of a coiled compression spring 36 tending to force apart the two heads 31 and 34. A further coiled compression spring 37 acts between the head 31 and the end of the casing 29 so as to keep the stem 32 in firm contact with the piston 26. The movement of the stem 33 within the valve element 31, 32 is limited by a pin 38 which is secured to the head 31 and passes through a slot 39 in the stem 33. As the piston 26 is moved downwardly by pressure fluid, as will be hereinafter explained, the spring 37 causes the valve element 31, 32 to follow, while the spring 36 firmly holds the head 34 of the second valve element in contact with the seating 35. Just before the head 31 reaches the fixed seating 30, however, the pin 38 contacts with the lower end of the slot 39, and thus the final movement of the valve element 31, 32 closes the seating 30 and at the same time causes the head 34 to leave the seating 35. A valve device of identical construction is fitted to the jack 11 and is indicated generally at 29a.

The system as a whole is a double-acting one and is supplied with fluid under pressure to a pipe connection 40 in order to unlock and lower the two plungers 12 and 13 while pressure fluid fed into the opposite pipe connection 41 correspondingly raises the plungers 12 and 13 until they automatically become locked, a sloping surface 42 on each plunger being arranged to slide past oblique surfaces 43 on the locking levers 20

until such time as the latter are free to move inwardly and hold the plunger in a locked condition. The action of the valve devices 29, 29a in accordance with the invention is as follows. When pressure fluid is fed into the connection 40 it passes into spaces 44 and 44a in the respective valve devices by way of main connections 45 and 45a. Both jacks being locked, the valve elements are in the positions shown in Figure 1, and therefore the fluid passes through the valve seatings 30, 30a and presses downwardly the two pistons 26 and 26a, thus moving outwardly the lower ends 19 of the locking levers 20. At the moment when the plungers 12 and 13 are free the heads 31 and 31a reach the fixed seatings 30 and 30a so that the supply of fluid from the main connection 45 is transferred past the seating 35 to a pipe 46 which leads to the jack connection 15, thus enabling said fluid to extend the jack 11. Similarly the fluid fed through the main connection 45a passes through a pipe connection 46a and has the effect of extending the jack 10. In the event of say the jack 10 becoming unlocked prior to the jack 11 it will be seen that the fluid from the main connection 45 is transferred by the opening of the valve seating 35 to a pipe 47a which enables the pressure fluid from the valve device 29 to act upon the piston 26a until such time as this piston has completed its movement. At the same time pressure fluid is fed to the connection 15, but, of course, it cannot effect the extension of the jack 11 until the corresponding locking means have been released. Thus, the two valve devices 29, 29a act as changeover valves, and each feeds either the corresponding locking means or else the other jack according to the position occupied by the valve elements.

As shown in Figure 2 the jacks are associated in pairs and are indicated at 10, 11 and 10a, 11a, the input of pressure fluid from a pipe connection 61 to the unlocking means of the jacks 10 and 11 being controlled by an auxiliary valve device indicated at 60, while a similar valve device 60a is associated with the two jacks 10a and 11a. The locking means of the four jacks comprise pairs of levers 20 adapted to hold the plunger members 12, 13 and 12a, 13a in their fully raised positions, said levers 20 being actuated by valve devices 62, 63 and 62a, 63a, all identical in construction. For actuating the auxiliary valve devices 60 and 60a however, transverse links 64, 64a are carried by the stems 25 and 25a respectively and are connected at their middle points with push rods 65, 65a. The lower end of each of these rods acts through a lever 71, 71a and serves to raise a push rod 72, 72a passing slidably through the casing of the corresponding auxiliary valve 60 or 60a and each is thus arranged to operate a corresponding pair of valve members indicated at 66, 69 and 66a, 69a respectively. The stems of these valve members are telescopically slidable and are interconnected by pin and slot devices 73, 73a, while springs 70 and 70a serve to move the valve members 66, 66a upwards into contact with the push rods 72, 72a. A further spring 74, 74a in each auxiliary valve tends to hold the valve member 69, 69a upon its seating but the slot of the pin-and-slot device 73, 73a is of such length that the valve member 69, 69a is moved off its seating just as the corresponding valve member 66, 66a is engaged with its seating 68, 68a during the upward movement of the push rod 72, 72a. Thus when pressure fluid is fed through the connection 61 it is allowed to pass to the connection 40 feeding the valve devices 62 and 63 of the jacks 10 and 11, while the fact that the head of the valve member 66a is off its seating 68a enables the pressure fluid similarly to reach the pipe connection 40a feeding the valve devices 62a and 63a of the jacks 10a and 11a respectively. The action in each pair of jacks is such that the release of both locking means of any one pair of jacks causes the centre part of the corresponding link 64 or 64a to be moved downwardly sufficient to close the valve seating 68 or 68a and open the corresponding passage past the head of the valve member 69 or 69a in the auxiliary valves. Assuming that the two jacks 10 and 11 become unlocked before the jacks 10a and 11a this will mean that the supply of fluid through the pipe connection 40 is cut off and the feed through the pipe 61 therefore passes through a connection 81 leading to the connection 40a, which latter it will be seen is already connected with the supply 61 by way of the valve seating 68a. Thus, the whole of the fluid pressure is concentrated upon unlocking the jacks 10a and 11a, and when this has been effected the consequent lowering of the centre part of the link 64a allows the valve seating 68a to be closed and the valve member 69a to be opened. This action enables fluid from the pipe connection 61 to pass the valve member 69a and thus reach the pipe connection 40, from which latter it flows into the valve devices 62 and 63 and thence to the cylinder connections 14 and 15, since the unlocking of the plungers 12 and 13 has already opened the valve seating 35 in the manner previously explained. The jacks illustrated are double-acting ones, and the fluid pressure used for closing or shortening them is supplied through a connection 41 having branches connected to the respective cylinders at 16, 17, 16a and 17a.

It will be noted that push rod 72, although normally abutting valve 66, is not actually integrated therewith; and that the closing of the valve 66, as well as the subsequent holding of said valve in the closed position, is due to the expansive force of spring 70, and is therefore independent of the exact position of the push rod 72, once said push rod has been withdrawn upwardly in response to release of locks 20. Hence any slight inaccuracy in the lock actuating linkage, or any subsequent loss of pressure thereupon, will not interfere with the continued, independent, maintenance of valve 66 in the firmly seated position, pending return of the locks to the locking position. The foregoing applies correspondingly to valve 66a, of course.

Various modifications may, of course, be made in the arrangements described, and the principle shown in Figure 1 may be extended to embrace any number of jacks operated from a common source of pressure fluid. Thus, as shown in Figure 2 the same general method can be used for interlocking three jacks. The middle and left hand jacks are identical with the jacks 10 and 11 shown in Figure 1, and are provided with an auxiliary valve 60 as before. The third jack, indicated at 10b is provided with a valve device 62b which is identical with the valve devices 62 and 63 but is connected so as to function similarly to the previous auxiliary valve 60a. Thus, if the jack 10b is the first to become unlocked, the valve seating 30b is automatically closed, and the supply of fluid from the conduit 61 is diverted to the valve devices of the jacks 10 and 11 by way of the conduit 46b, and it is not until

the auxiliary valve 80 is actuated by the unlocking of both these jacks 10 and 11, that the supply of fluid can pass through the conduit 81 and reach the working space of the jack 10b to extend its plunger 12b. In cases where the jack is locked in its completely extended position the same general arrangements can be used, except, of course, that the pipe connections 14 and 15 to the jack cylinders would be interchanged with the connections 16 and 17 respectively, suitable modification being made in the mechanical details of the locking mechanism. In some cases it may be desirable for the plungers to be locked at each extreme position, and for this purpose the interlocking valve systems shown can be duplicated.

Although this invention has been described in connection with certain specific embodiments, the principles involved are susceptible of numerous other applications that will readily occur to persons skilled in the art. The invention is, therefore, to be limited only as indicated by the scope of the appended claims.

This application is a continuation in part of my application No. 173,928 filed November 10, 1937.

What is claimed is:—

1. A fluid operated system including a plurality of jacks and a locking means for each jack, means for releasing the locking means by pressure fluid fed to the jack, a valve device associated with each pair of said jacks for arresting the flow of fluid to one pair of jacks when both locking means therefor have been released, and for leading said fluid to another pair of jacks, resilient means associated with each valve device for holding the same in position to arrest flow to the associated pair of jacks and jack releasing means, said resilient means being operative upon release of the associated locking means, means abutting each valve device prior to release of the locking means to physically bar movement thereof to the flow arresting position, lock operating means for withdrawing said abutting means beyond the limit of expansion of said resilient means, so that the latter becomes operative to hold the associated valve device in said flow arresting position without further opposition from said abutting means, and independently of the exact position of the locking means, pending return of the locking means to locking position.

2. A fluid operated system including a plurality of jacks and a locking means for each jack, means for releasing the locking means by pressure fluid fed to the jack, and a valve device associated with each pair of said jacks for arresting the flow of fluid to one pair of jacks when both locking means therefor have been released, and for diverting said fluid to another pair of jacks, each of said valve devices having relatively movable sections connected by pin and slot connections and having resilient means normally urging said sections to the above described flow arresting and flow diverting positions, respectively.

3. A fluid operated system including a plurality of jacks and a locking means for each jack, means for releasing the locking means by pressure fluid fed to one pair of jacks, and a valve device associated with each pair of said jacks for arresting the flow of fluid to one pair of jacks when both locking means therefor have been released, and for diverting said fluid to another pair of jacks, each of said valve devices having relatively movable sections and including means to hold the relatively movable sections in the above described flow arresting and flow diverting positions, respectively.

SYDNEY MACDONALD PARKER.