P. GAUER.

HYDRAULIC LIFTING GEAR.

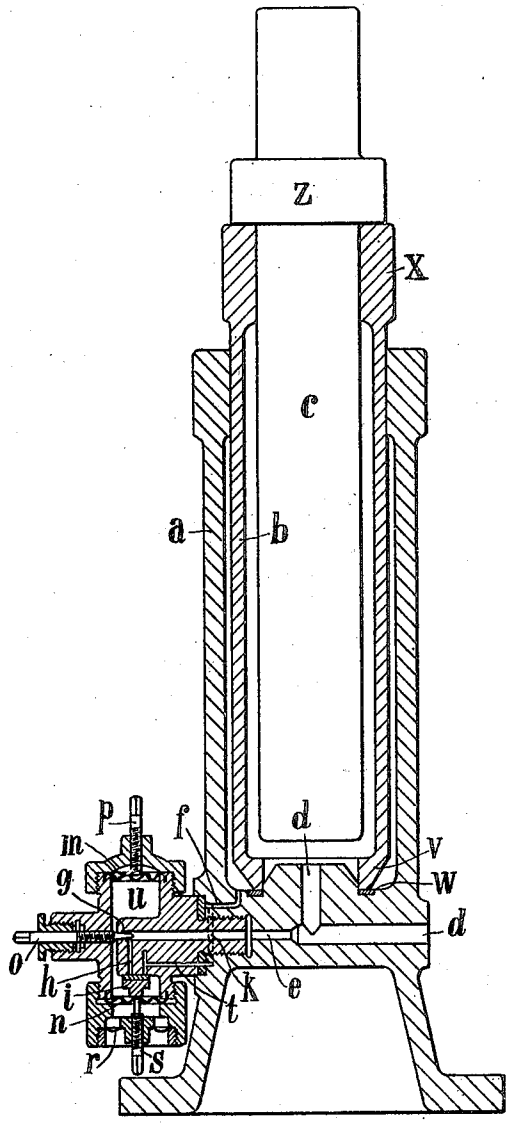
APPLICATION FILED AUG. 21, 1907.

902,723.

Patented Nov. 3, 1908.

2 SHEETS—SHEET 1.

Fig. 1.



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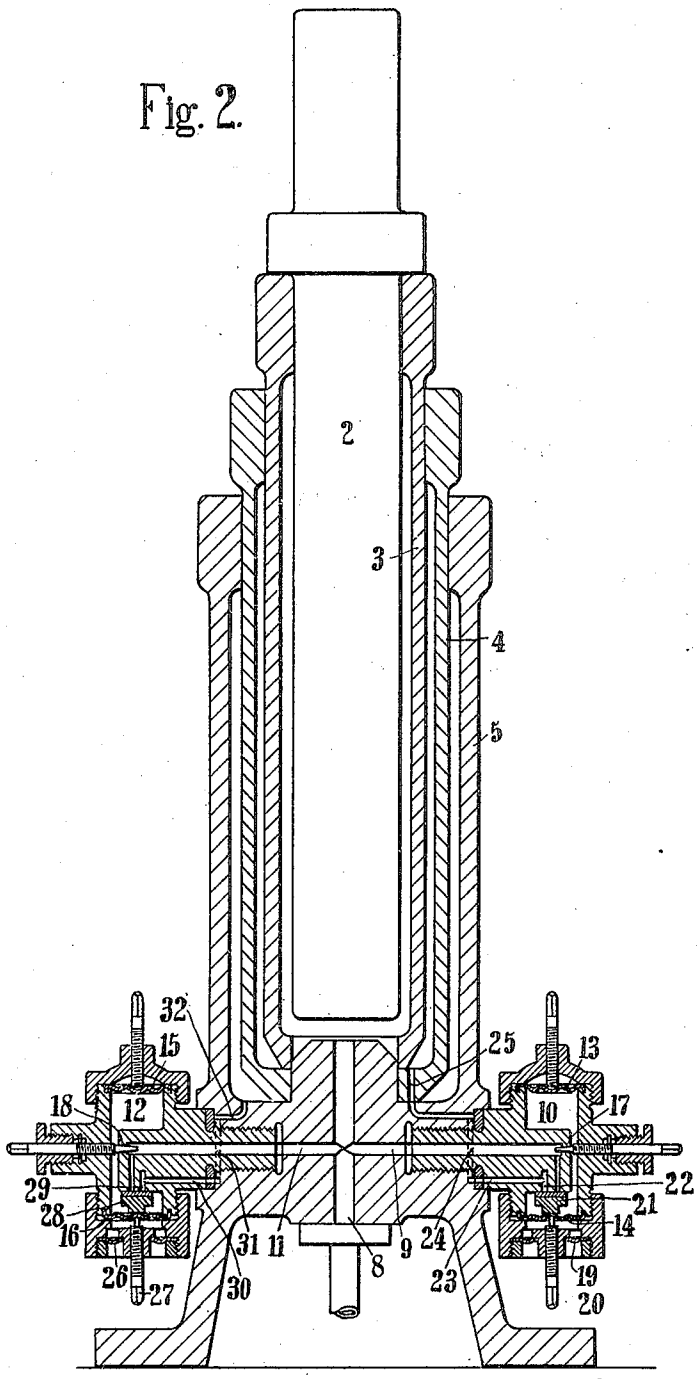
2 SHEETS—SHEET 2.

Fig. 2.



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HYDRAULIC LIFTING-GEAR.

No. 902,723. Specification of Letters Patent. Patented Nov. 3, 1908.

Application filed August 21, 1907. Serial No. 389,505.

To all whom it may concern:

Be it known that I, PAUL GAUER, a subject of the German Emperor, residing at St. Petersburg, in the Empire of Russia, have invented certain new and useful Improvements in Hydraulic Lifting-Gear, as set forth in the following specification.

My invention relates to hydraulic lifting gear or jacks having several pistons supported telescopically displaceable within each other.

In hydraulic lifting gear or jacks for lifting loads which consist of several pistons supported telescopically displaceable within one another it has hitherto been necessary to use very complicated arrangements to enable the pressure-water to act first on one piston only and, when the load increases, to act automatically on the other pistons in succession and these arrangements have been found to be unreliable in their general action so that such lifting gear has not come into general use.

The defect pointed out above is done away with successfully according to the present invention by means of an arrangement which is distinguished from previous arrangements of this kind by being exceedingly simple, the result of which is that the intended action can be guaranteed with certainty. For this purpose the space in which each preceding piston is arranged communicates through a closing device with a chamber closed by a diaphragm in such a manner that when the pressure increases in the said chamber a closing device connected with the diaphragm opens the admission passage to the chamber below the next piston. The arrangement above referred to at the same time permits the controlling members in question to be completely inclosed by a casing so that they are not disturbed by the action of external influences.

In the accompanying drawings two embodiments of the present invention are shown by way of example.

Figure 1 is a sectional view of one embodiment, and Fig. 2 is a sectional view of another embodiment of the invention.

Referring particularly to the device shown in Fig. 1, *a* is the cylinder in which the two pistons *b*, *c* are supported telescopically displaceable in one another. The piston *c* is provided with the collar *z* by means of which it rests on the edge *x* of the outer piston. This outer piston terminates at its lower end in the pointed end *v* and rests at said end on the bottom *w* of the cylinder. *d* is the port through which the pressure water is led into the space between the inner piston and the outer piston. From this port *d*, a port *e* leads into a pressure chamber *u* which is closed at its ends by means of the steel diaphragms *m* and *n*. The port *e* is connected through the opening *g* with the chamber *u* which can be closed more or less by means of the regulating screw *o* according to requirement. The diaphragm *n* is adjustably stiffened by means of a second diaphragm *r* and a set-screw *s* and a cushion (valve-body *i*) presses against the ports *h* and *t*, of which *t* is connected by means of the annular port *k* and the port *f* with the space between the cylinder *a* and the piston *b*. While the diaphragm *r* serves to adjustably stiffen the diaphragm *n* the diaphragm *m* and the adjustable screw *p* which limits its travel determine that limit of the load which produces the lifting of the body *i* from its seat.

The operation is as follows:—The pressure-water enters through the port *d* under the piston *c* into the space formed between the pistons *c* and *b* and at the same time passes through the opening *g* into the chamber *u*. If now the load is small the pressure-water passing into the cylinder only raises the inner piston *c* together with the load. When the load increases the water-pressure in the chamber *u* increases gradually and in fact increases to become approximately equal to the pressure obtaining in the port *d*, the diaphragm *m* being bent outwards. In proportion as the load further increases the diaphragm *m* is bent outwards still further until it finally abuts against the adjusting screw *p* when the water-pressure in the chamber *u* increases to become approximately equal to the pressure obtaining in the port *d*. By these means the diaphragm *n* is somewhat raised, and in consequence thereof the pressure-water now passes out of the port *e* into the port *t* and from the latter through port *k* and port *f* into the space between *b* and *a*. The pressure-water now acts also on the piston *b* and displaces the latter until it presses with its edge *x* against the collar *z* of the piston *c* whereupon both pistons in common effect the raising of the load. If the valve-body *i* is to be raised from its seat even while the load on the hydraulic jack is slight, it is only necessary to reduce the distance between the screw *p* and the diaphragm *m*. On

the other hand, when the distance between the diaphragm *m* and the screw *p* is increased, the piston *c* will be enabled to overcome a greater force or to lift a greater load before the piston *b* comes into action.

The embodiment shown in Fig. 2 differs from the form above referred to by having three pistons 2, 3, 4 arranged in the cylinder 5 instead of only two. 8 is the port through which the pressure-water is led into the space between the piston 2 and the piston 3. From this port 8, a port 9 leads into a pressure-chamber 10 and a port 11 into a pressure-chamber 12. The pressure-chamber 10 is closed at its ends by means of the steel diaphragms 13, 14, and the chamber 12 is closed by means of the steel diaphragms 15, 16. The port 9 is connected through the opening 17 with the chamber 10, and the port 11 is connected through the opening 18 with the chamber 12. The diaphragm 14 is adjustably stiffened by means of a second diaphragm 19 and a set-screw 20, and a valve-body 21 presses against the ports 22 and 23, of which 23 is connected by means of the annular port 24 and the port 25 with the space between the pistons 3 and 4. The diaphragm 16 is adjustably stiffened by means of a second diaphragm 26 and a set-screw 27, and a valve-body 28 presses against the ports 29, 30, of which 30 is connected by means of the annular port 31 and the port 32 with the space between the piston 4 and the cylinder 5. The diaphragms 13, 14 and 19 are more flexible than the diaphragms 15, 16, 26.

The operation of the pistons 2, 3 is the same as previously described. When the load increases the water-pressure in the chamber 12 increases gradually until the diaphragm 16 is bent outwards and the pressure-water now passes out of the port 11 into the port 30 and from the latter through the port 31 and port 32 into the space between the piston 4 and the cylinder 5.

Naturally the number of telescopically displaceable pistons may be varied as desired and instead of water any other pressure liquid, for example carbonic acid and the like, may be employed. For the liquid pressure-medium a gaseous pressure-medium may of course be substituted without anything whatever being altered in the essence of the present invention. The pistons may act directly or indirectly on the load to be raised.

Having now fully described my invention, I declare that what I claim is:—

1. In a hydraulic lifting gear, the combination of a cylinder, two pistons supported in said cylinder telescopically displaceable in one another, means for causing the pressure-water to act first on one piston and, when the load increases, to act automatically on the other piston, comprising a chamber adapted to communicate with the space below the inner piston, means for shutting off said chamber, and means for opening the admission passage to the space under the outer piston when the pressure increases in said chamber.

2. In a hydraulic lifting gear, the combination of a cylinder, a plurality of pistons supported in said cylinder telescopically displaceable in one another, means for causing the pressure-water to act first on one piston and, when the load increases, to act automatically on the other pistons in succession, comprising chambers adapted to communicate with the space below the innermost piston, means for shutting off said chambers, and means for opening the admission passage of each chamber to the space under one of the following pistons when the pressure increases in said chamber.

3. In a hydraulic lifting gear, the combination of a cylinder, a plurality of pistons supported in said cylinder telescopically displaceable in one another, means for causing the pressure-water to act first on one piston and, when the load increases, to act automatically on the other pistons in succession, comprising chambers, each chamber being adapted to communicate with the space below the innermost piston, means for shutting off each chamber, each chamber being closed by a diaphragm and provided with a closing device arranged between said chamber and the space under one of the following pistons, said closing device being adapted to be opened when the pressure increases in said chamber.

4. In a hydraulic lifting gear, the combination of a cylinder, a plurality of pistons supported in said cylinder telescopically displaceable in one another, means for causing the pressure water to act first on one piston and, when the load increases, to act automatically on the other pistons in succession, comprising chambers, each chamber being adapted to communicate with the space below the innermost piston, means for shutting off each chamber, each chamber being closed by a diaphragm and provided with a closing device arranged between said chamber and the space under one of the following pistons, said closing device being adapted to be opened when the pressure increases in said chamber, a second diaphragm, and a set-screw for said latter diaphragm adapted to act against the closing device of the latter.

5. In a hydraulic lifting gear, the combination of a cylinder, a plurality of pistons supported in said cylinder telescopically displaceable in one another, means for causing the pressure-water to act first on one piston and, when the load increases, to act automatically on the other pistons in succession, comprising chambers, each chamber being adapted to communicate with the space under the innermost piston, means for shutting off each chamber, each chamber being closed

by a diaphragm and provided with a closing device arranged between said chamber and the space under one of the following pistons, said closing device being adapted to be opened when the pressure increases in said chamber, a second diaphragm, a set-screw for said second diaphragm adapted to act against the closing device of the second diaphragm, a third diaphragm, and a set-screw for said third diaphragm.

In testimony whereof I affix my signature in presence of two witnesses.

PAUL GAUER.

Witnesses:

H. A. LOVIAGUINE,

AUG. MIGHIS.