2 Sheets—Sheet 1.

W. B. HYDE.

Hydraulic-Lift.

No. 216,326. **Patented June 10, 1879.**

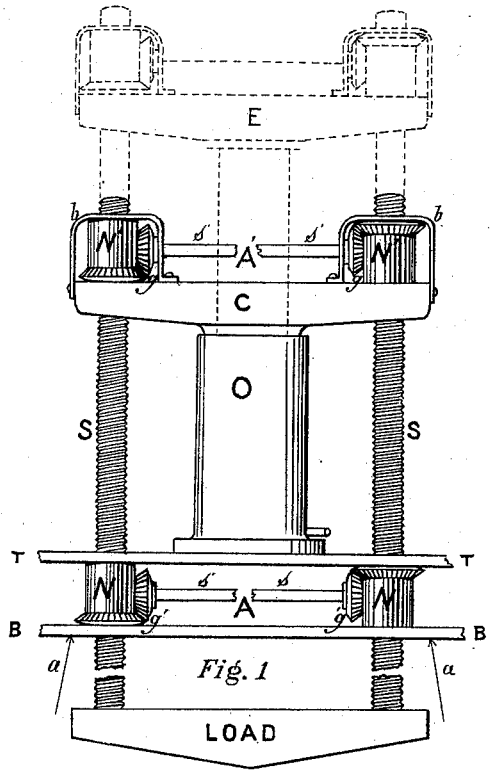

Fig. 1

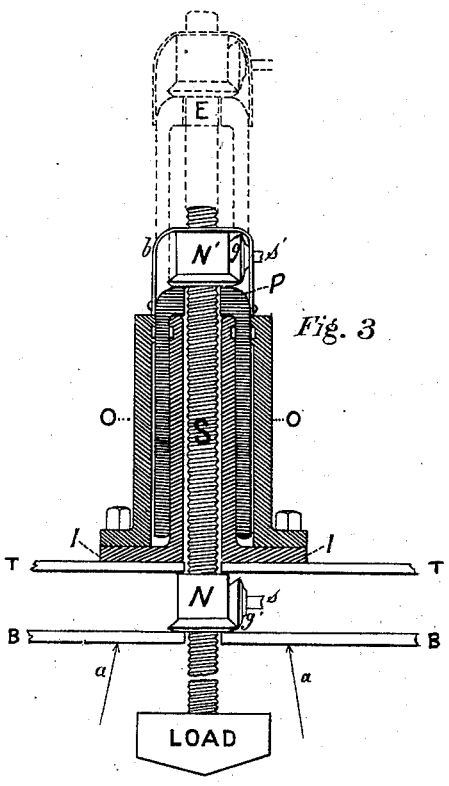

Fig. 3

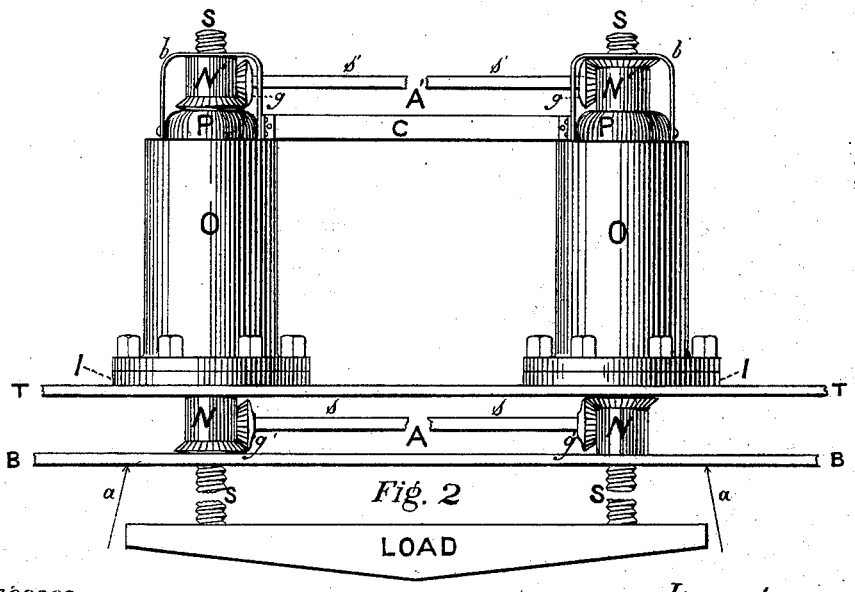

Fig. 2

Witnesses
Geo. H. Strong.
Frank A. Brooks

Inventor
William B. Hyde

2 Sheets—Sheet 2.

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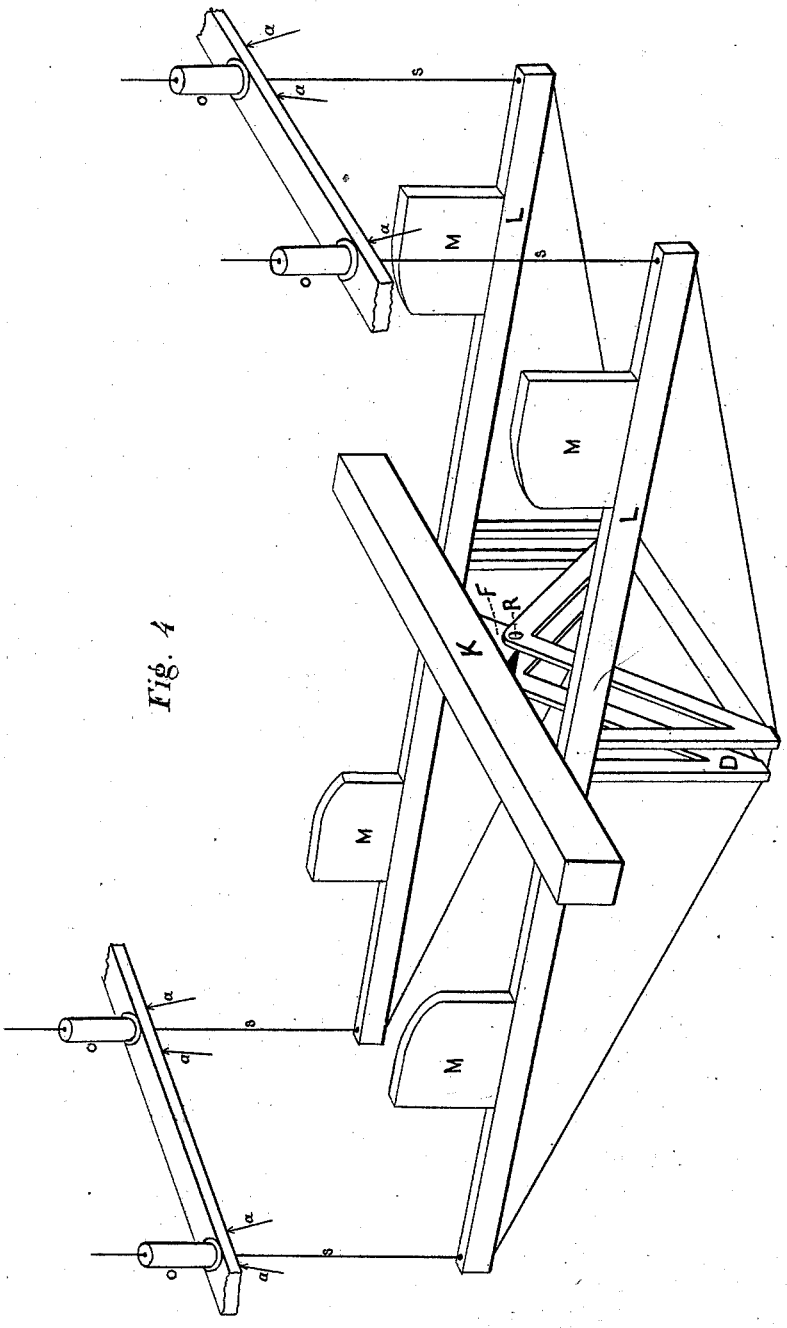

Fig. 4

Witnesses
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UNITED STATES PATENT OFFICE.

WILLIAM B. HYDE, OF OAKLAND, CALIFORNIA.

IMPROVEMENT IN HYDRAULIC LIFTS.

Specification forming part of Letters Patent No. **216,326,** dated June 10, 1879; application filed September 7, 1878.

To all whom it may concern:

Be it known that I, WILLIAM B. HYDE, of the city of Oakland, county of Alameda, and State of California, have invented an Improved Hydrostatic Lift; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings.

My invention relates to certain improvements in that class of dry-docks or lifting apparatus in which hydrostatic pressure is employed to lift the vessel or other weight by means of suitable connections with the dock sections or weights; and it consists in the employment of lifting-cylinders having a length shorter than the lift to be accomplished, in combination with a novel means of fleeting back for a new lift, and devices whereby the load is sustained during the said partial lifts or fleets, whether it be to lift or depress the load.

My invention further consists in the employment of a peculiarly-constructed annular cylinder, through which the weight is centrally supported.

In order to more thoroughly explain my invention, reference will be made to the accompanying drawings, in which—

Figure 1 is a view, showing the method of operating the lift by means of a single cylinder carrying two screw-rods on the ends of a cross-head. Fig. 2 shows the use of a pair of cylinders, one at each end of a cross-head, and having screw lifting-rods passing up through the center of each lifting cylinder and piston. Fig. 3 is a longitudinal section through the center of one of the annular cylinders and its piston. Fig. 4 is a view of a dock-section with my improved adjustable or rocking keel-block.

In order to more perfectly explain my improvements, I will refer briefly to the principal methods which have been employed in the construction of this class of lifting apparatus.

Clark, of England, in the construction of the Victoria bridge across the St. Lawrence, used a hydrostatic press of short stroke or lift to lift into position the tubular iron spans of the structure. The essential elements of his device were a chain attached to the load, and so made that at certain distances it could be chocked and held while the ram of his lifting-press descended to get a new hold, gripe, or bearing on said chain, and in this manner by successive short lifts or fleets the load was lifted into place.

Shortly subsequent to the completion of this structure, Clark applied hydrostatic presses to the purposes of docking vessels. In the construction of the Victoria docks in England his method embraced the use of vertical presses of a long stroke, sufficient to take a vessel out of the water without fleeting the lifting-connections. These connections were made from the cross-heads of each press down to the extremities of the athwartship trusses or beams, which being placed side by side in sufficient number made a line of bearings to take and sustain the largest vessels. That dock is in successful operation at this date.

Prior to the application by Clark of hydrostatic presses to lifting his bridge-spans the use of said pressure had been made for docking purposes in the old hydrostatic and screw dock of New York, where a succession of cross and cradle trusses were suspended by chains leading vertically up and over sheaves, and then the parts all led horizontally and grouped to an attachment to the piston of a single horizontal hydrostatic press of short stroke on each side of said dock.

A pawl system engaging with a heavy rack held the load during the interval in which the press-piston was returning from full stroke back to get a new hold—in other words, while fleeting. In this dock the adjustment of each cross or cradle truss up under the vessel to be docked was made by a screw device as part of the lifting-chain for each truss.

On the 11th of October, 1875, Theo. A. Blake secured a patent for an improved combination whereby the fleeting in raising or lowering heavy weights or vessels should be accomplished with more facility than by the arrangement of Clark in his Victoria bridge machinery, while at the same time making substantially the same use of Clark's method of short-stroke presses placed vertically and directly over each end of each truss-load to be lifted.

The mechanical difficulties of actually constructing and operating a dock for very heavy vessels of several thousand tons upon this device would be very great, while the applica-

tion of the Clark system of short-stroke presses over the ends of the truss-loads to be lifted presents many economical elements, which, if combined with a simple, easily and delicately adjustable lifting or pulling connection between the load and the presses, would give a useful and valuable practical improvement in the methods of docking vessels or lifting or moving unusually heavy weights by short strokes or fleets.

My device is intended to supply the adjustable lifting-connection between the load and presses in a manner which shall render the use of this class of docks more practical than by the present system.

A base or abutment to support and receive the thrust of the hydrostatic press or presses is so made as to leave an open space between its upper face, T T, and lower portion, B B. Such space would be left by using channel or T-rolled beams, and connecting them at top and bottom by plates, the whole resting on piers or columns. (Indicated by arrows *a a*.)

A pair of iron or steel rods, S S, with a screw-thread turned or cut upon each nearly its entire length, are attached to the load to be lifted in such manner that they may pass through openings left in the top and bottom plates of the press-supports T T B B, and then upward through similar openings in the extreme ends of the cross-head C of the piston of the hydrostatic press H.

As said rods are passed up through the openings of the base, nuts N N, placed between the upper and lower plates of such base, are run down on the screw-thread of the rod, holding said rods in any position that may be desired by the sustaining power of said nuts on the lower plate or base, B B, resting directly upon the piers or columns *a a*.

Upon the ends of the rods projecting above the cross-head C, nuts N′ N′ are run down to a bearing upon the upper face or surface of said cross-head. A bonnet or cap, *b*, is then put over each nut and permanently attached to the cross-head, the screw-rod being free to run through such bonnet or cap, as also through the ends of cross-head and the openings in the base-support by hubs provided of diameter slightly greater than the outside diameter of such rod, so that there shall be no binding of said rod against the sides of any of said openings.

If, now, sufficient hydrostatic pressure be applied within the cylinder of the press H the piston will move outward, carrying up with it the rods S S and their load by means of the cross-head resting on the nut-supports N′ N′. This can only be done, however, by causing the lower nuts, N N, to revolve with such speed that they shall always keep free from a bearing against the upper part of the base T T. In short, they must be revolved with a speed and force easily sufficient to cause them to lightly bear against the lower plate, B B, of the base; and thus at every instant of time and for the most minute forward or outward movement of the piston carrying the rods and load, these lower nuts are in position to assume the entire support of the total load without jar, concussion, or blow, and therefore without any undue strains on the parts.

To secure this proper revolution of these nuts they are to be of cast-steel, with a beveled projection of teeth around one end, into which engages a pinion, *g′*, one end being placed so that its gear end shall be down while the other is up. Thus two pinions, operating both nuts simultaneously, may be connected by the same shaft *s s*; and at the center, A, a suitable motive power is provided, of power and speed sufficient to turn the nuts through the pinions with the speed requisite invariably to keep clear of the upward or downward movement of the screw-rods through or past the base-plates.

As a motive power, the most economical, positive, and safe to be applied to the pinion-shaft *s s*, I prefer a small multi-cylinder hydraulic engine, such as Ramsbottom's, attached directly to the shaft *s s* at A, and fed with water by pipes from the engine-room. With such an engine no valve-motion is requisite; but the engineer can instantly produce motion by turning on his pressure in the engine-room, and can as instantly reverse the same by making the exhaust-pipe the pressure-pipe and the pressure-pipe the exhaust.

There are many other ways in which the nuts may be operated, some of which, under conditions where but single presses are used, may be better than the one indicated; but for a long row of presses operating a series of dock-sections simultaneously, and all to be under the instant control of the engineer in the engine-room, the hydraulic engine offers the greatest advantages.

When the piston of the press H has moved outward its full stroke, if the load is to be lifted or moved still further the piston must be fleeted back to its first position. This, with my invention becomes at once a simple and absolutely safe operation, the lower nuts, N N, assuming the load by bearing against the under surface of the upper face of the abutment T T and holding the rods S and load.

The upper nuts, N′ N′, are cast of steel, in the same shape as the lower nuts, and are connected and operated by pinions G G and shaft *s′ s′*, as with the lower nuts. At A′ a similar hydraulic or other motor is attached, and, if hydraulic, the supply and exhaust pipes are flexible, and connected with the permanent supply-pipes of the lower motor. This flexibility of connection permits the piston and cross-head to rise and fall, carrying or followed by the upper nuts and connections, without impeding the prompt action of the upper motor at A′ upon the pinions or nuts.

The piston and cross-head having lifted the rods and load to the position shown by the dotted lines at E, the pressure within the press-cylinder is relieved at the engine-room, and by suitable valves there the fluid in the press

is permitted to flow back to the engine-room through the same pipe, and the piston by its own weight descends.

The pressure in the hydraulic motor at A′ has been constant during the entire time of the lift of the piston, so that the tendency of the motor has been to turn or run the nuts down the screw-rod throughout the time of the lifts. This tendency has been resisted by the fact of the nuts being jammed against the face of the cross-head, and held there by the weight sustained. At the instant, however, that the piston stops in its outward movement and commences to descend, the "jam" is changed from the upper nuts to the lower ones, and the upper motor at once commences to operate, turning its nuts down on the screw-rod, gently bearing on the face of the cross-head meanwhile until the piston stops and commences the outward motion again, when again the jam of the lower nuts is relieved and transferred to the upper nuts, which take the load, carrying it upward with the piston for as many strokes or any part of a stroke as may be desired.

From this description it will be seen that by a series of these presses along one side of a dock, mated by a corresponding series along the opposite side, all connection by screw-lift rods firmly with the extremities of a series of dock-sections, can be easily operated by one skilled man in the engine-room.

It being determined what water-pressure within the cylinders of the upper and lower hydraulic motors operating the nuts is necessary to overcome the sum total of all fractional elements of resistance to such turning, a pressure a little superior to this determined is turned on to such motors and simply kept constant during the operation of lifting a vessel or load. Then the alternate sending into the presses of high-pressure fluid and admitting it back again comprise the essential manipulations from the engine-room in raising a vessel or load any required distance which the length of the screw-rods permits.

To lower a vessel or other heavy weight an additional manipulation is required. The load is finally sustained by the lower nuts, N N; and to lower the load so that the screw-rods may descend through the openings in the base-plates, it is essential to take the weight fully on the upper nuts, and, relieving the lower nuts, turn them so that the rod may descend through them without hindrance until the end of the piston downstroke is reached. The water-pressure feeding and operating the nut motors is reversed in the engine-room, so that the motors now have the tendency to run the nuts up the rods. This tendency produces no effect upon the lower nuts, as the support of the load jams them against the lower plates, B B; but the upper nuts, in their effort to run up the screw-rods, at once seek a bearing against the under side of the bonnets E E. In this condition, the pressure, or sufficient for the purpose, being applied within the cylinder of the press, the piston rises without any load as the upper nuts, N′ N′, by the reversed action of the motor, run away from contact with the cross-head as it rises. At a suitable point—say, one-quarter or a half an inch—just before the completion of the upward unloaded stroke of the piston, the upper motor is stopped by the interposition of a suitable device at the selected point, which shuts the motor's inlet-valve, and thereby stops the revolution of the upper nuts. The piston, however, continuing its upward motion, its cross-head at once takes a bearing under the arrested nuts and assumes the entire load, thereby relieving the lower nuts, which, by their previous condition of jam against the lower bearing, had resisted the effort of their motor to turn them up to a bearing against the under side of the base-plate T T. When relieved, however, they instantly assume such a relation with this upper head-plate, and although within a sixteenth of an inch of the lower plate, which is all the play that I should allow the nuts between top and bottom plates, their motor will revolve them up the rod fast enough to offer no impediment to the descent of the rods and load throughout the given stroke. The piston and cross-head therefore having assumed the load, and the lower end being free, and by the pressure in its motor straining to turn to keep out of the way of the descent of the rod and load, it rests with the engineer to allow the main hydrostatic pressure to cease and be reversed, so that the piston expelling the liquid in the cylinder slowly settles with its load, the speed being regulated in the engine-room by the amount of choke given to the outlet-valve of the pressure-pipe.

At the outset of the descent, by the operation of the same device that closed the water-inlet to the upper motor, this inlet is again opened, so that the motor again exerts its tendency to turn the upper nuts up the rod, which they resist, being jammed against the cross-head by sustaining the load. When within a fraction of an inch of the bottom of the piston-stroke or descent the lower motor is stopped by the coming into action of a suitable device attached to the piston, and which at the point selected shuts off the inlet-water of such lower motor. The lower nuts thereby stop their upward revolution, and, the piston and load still descending toward the end of the stroke, these lower nuts are again brought to a bearing on the lower base-plate, and assume at once the entire load; and the piston, descending to the end of its stroke, relieves the upper nuts, which, being under strain by their motor, again and at once take bearing against the under side of their bonnet or cap *b*.

The operation of sending up the unloaded piston again can be made, and the subsequent operations repeated, until the vessel is in the water or the load lowered to the desired position.

In the construction of very large docks calculated to take up vessels of several thousand tons dead weight, the lift-rods, if placed in

proper attachment with the ends of the cross-trusses forming the basis of the sections into which such docks must be divided, will have to be separated so far as to make the construction of a safe cross-head C to the piston difficult, if not undesirable, on account of the size and clumsiness requisite to secure absolute safety under great loads. To meet this difficulty I have invented a form of press with an opening entirely through the piston and cylinder along their common axis, through which opening the screw-rod is raised or allowed to descend; and its axis being also common with that of the piston and cylinder, the forces exerted through this type of press upon a load suspended by such a screw-rod are centralized and conveyed upon the lifting-nut in such a manner as not only to completely avoid all danger of excessive friction against the sides of the piston, which in the solid piston and cross-head type may be due to any accidental difference in load on the two arms of the cross-head, but makes a press of much greater general stability, and one through which a single lift-rod may be used with maximum effect wherever such simplicity in construction may be desirable.

Fig. 2, Sheet 1, shows a pair of such presses, each having through its center a screw-rod, S, the lower end attached to the load. Fig. 3 shows a longitudinal section through the central axis of the press and piston.

Referring to Figs. 2 and 3, I shows the inner part of the cylinder, flanged at its lower part to form a broad base to sustain the whole cylinder and load, and entirely open through the center, where the screw-rod S is shown in position.

O shows the section of the outer shell of the cylinder, also flanged at the bottom, to rest upon and be bolted or otherwise fastened to the flange of the inner part of the cylinder I.

In the annular space between the inner and outer parts of the cylinder the hollow cylindrical piston P plays, secured against leakage by outer and inner packing usual in hydrostatic presses, placed, as shown in Fig. 3, at top of cylinder. The top of this hollow piston is cast with a curved head, as shown, so as to allow the screw-rod to pass through it with as little play as possible, and to take a full clean bearing under and all around the upper nut, N′. The bonnet *b* secures said nut to the top of this piston, as shown in Fig. 1, at the extremity of the cross-head.

Fig. 2 shows a pair of these annular-cylinder presses, arranged to work together by precisely the same mechanism and in the same manner, so far as relates to the movement of lifting-rods, nuts, and loads, as in the single press with cross-head.

The same letters refer to all the working parts; hence no additial description is necessary in explanation of this part of my invention.

In the preparation of working plans and details for a large two-thousand-ton dock, using the annular-cylinder presses, I found that economy of time, metal, and machine-work in finishing required the construction of my annular cylinder in two parts. I therefore consider that, apart from the merits of the type of press produced, the method of construction is a valuable and distinct element in the invention.

A dock constructed under my invention will be divided up into sections, each capable of taking on from fifteen to thirty feet of the keel-length of a vessel, and each suspended from the presses by four screw lift-rods. Very small docks may, perhaps, be constructed where each section shall be suspended and lifted by two rods, one at each end; but the sections of large docks will require rods from four points, each leading to and through an annular-cylinder lifting-press, or to the arms of a cross-head on a solid-piston press, as described.

It is obviously desirable in docking a ship to have the weight on a section so rest upon the keel-blocks of such section that the strains distributed through its cross-trusses to the suspending-rods shall impose equal duty upon each rod and its press.

To accomplish this with invariable uniformity, I have invented a rocking keel-block, K, for each section, which, resting upon a base, F, rocks upon a pin or pivot, R, in the center of the section, and enables the entire portion of the ship's weight that rests upon such section keel-block to be transferred by a suitable system of trusses, L L, uniformly to the four suspending-rods S S S S. This keel-block for large docks will be properly trussed by a system bringing all local keel-block strains to the pin-center, and thence throughout the cross-trusses to the rods. This system of making the dock-sections admits of unseen irregularities in the vessel's keel to be used by the vertical play of the keel-block, which being brought up under the vessel with pressure enough to lift her an inch out of water, the bilge-blocks M M are run in and placed, and the lifting completely out of water proceeded with.

Although the foregoing explanations have been based upon the theory of vertical direct lifts upon the sections of a dock, I do not confine myself to such application; but the advantage of my method of using such presses and rods applies equally to drawing up cradle-docks on incline planes, or, by a horizontal pull on chains passing over sheaves, operating docks similar to the old hydrostatic screw-dock of New York.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The tension rod or rods S, connected with the load to be moved, and having screw-threads cut upon them, as shown, in combination with the sets of nuts N N′, one set

serving as a bearing against which to apply power, while the other set act as checks, substantially as herein described.

2. The screw tension-rods S S, with their operating-nuts N N′, in combination with the hydrostatic press or presses O and the cross-head C, substantially as and for the purpose herein described.

3. The screw tension-rods S S, with the nuts N N′, pinions *g g′*, and shafts *s s′*, in combination with the hydrostatic presses O and the cross-head C, substantially as and for the purpose herein described.

4. The double concentric or annular cylinder O I, with its hollow cylindrical piston P, in combination with the tension or lifting rods S and the nuts N N′, with their connecting-gears and shafts, the whole operating substantially as and for the purpose herein described.

5. The screw tension-rods S S, with their nuts N N′, working between the plates B T and within the bonnet B, in combination with the hydrostatic presses O and the load or dock-section, substantially as and for the purpose herein described.

In witness whereof I hereunto set my hand.

WM. B. HYDE.

Witnesses:
FRANK A. BROOKS,
WALTER C. BEATIE.