(No Model.) 4 Sheets—Sheet 1.

B. GERDAU.

APPARATUS FOR SUPPORTING LOADS.

No. 591,076. Patented Oct. 5, 1897.

Fig. 1.

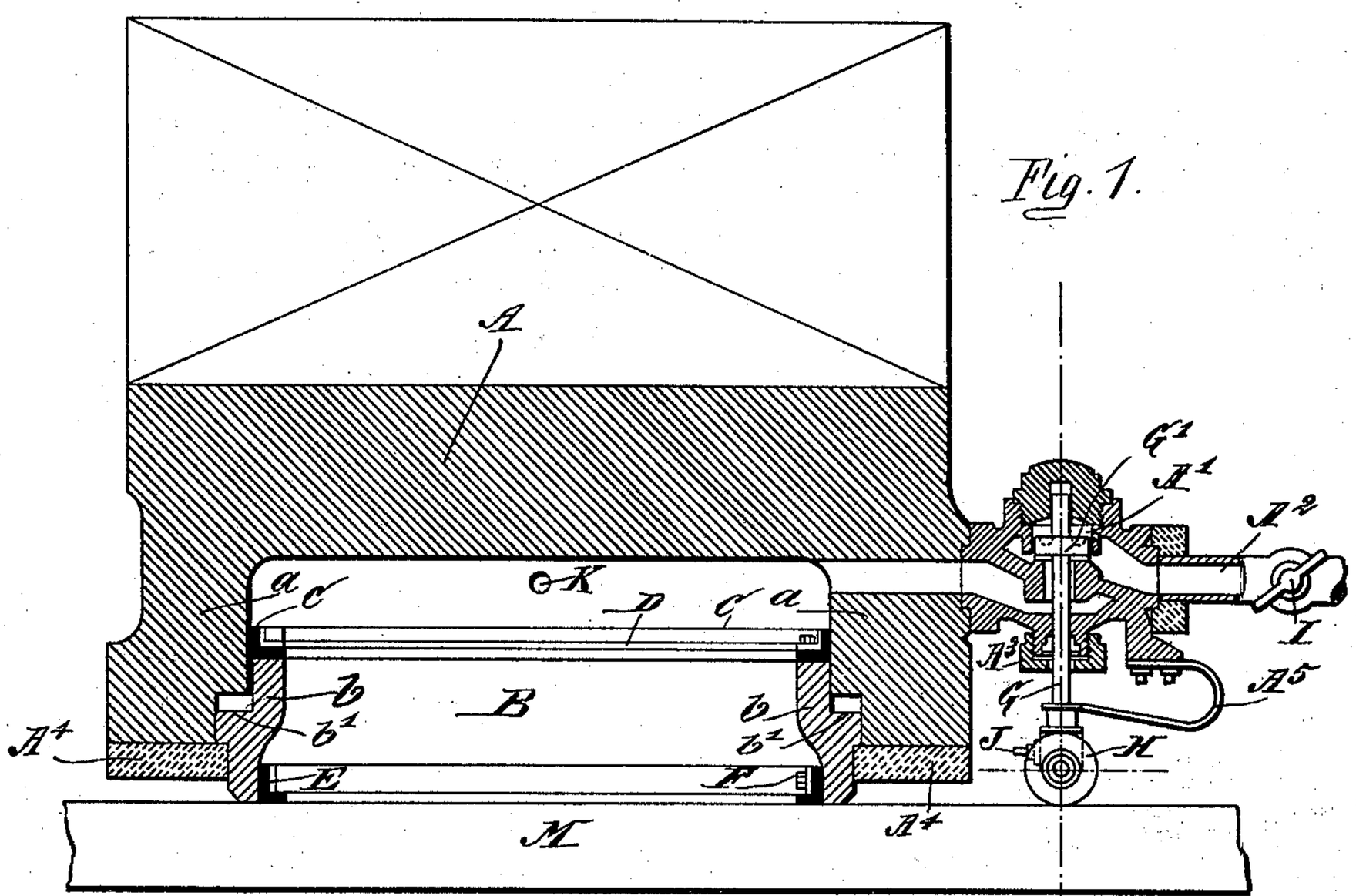
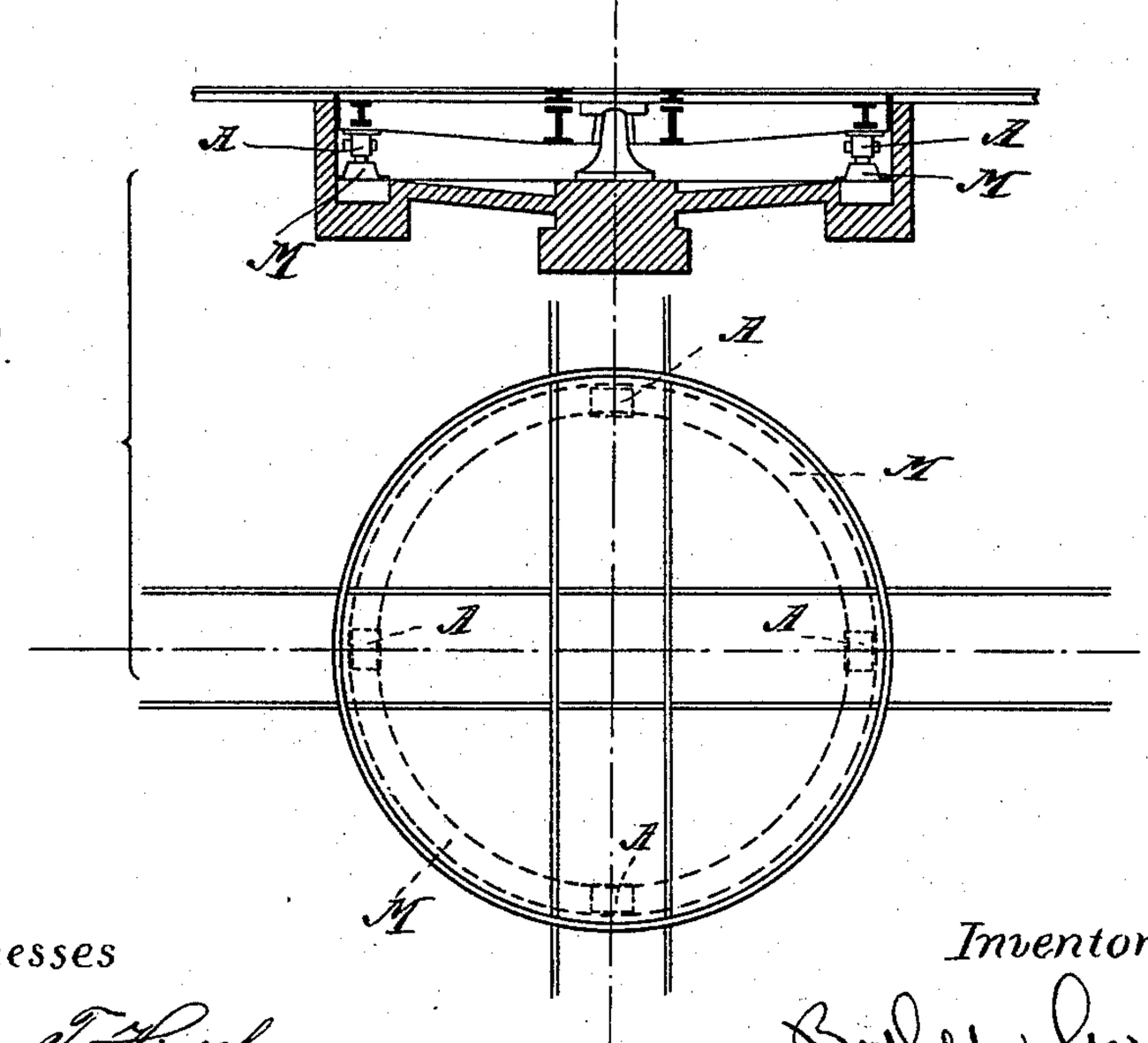


Fig. 2.



Witnesses
Henry J. Hirsch.
M. F. Boyle

Inventor
Berthold Gerdau
By Thomas Dyer Stetson
Attorney

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Fig. 3.

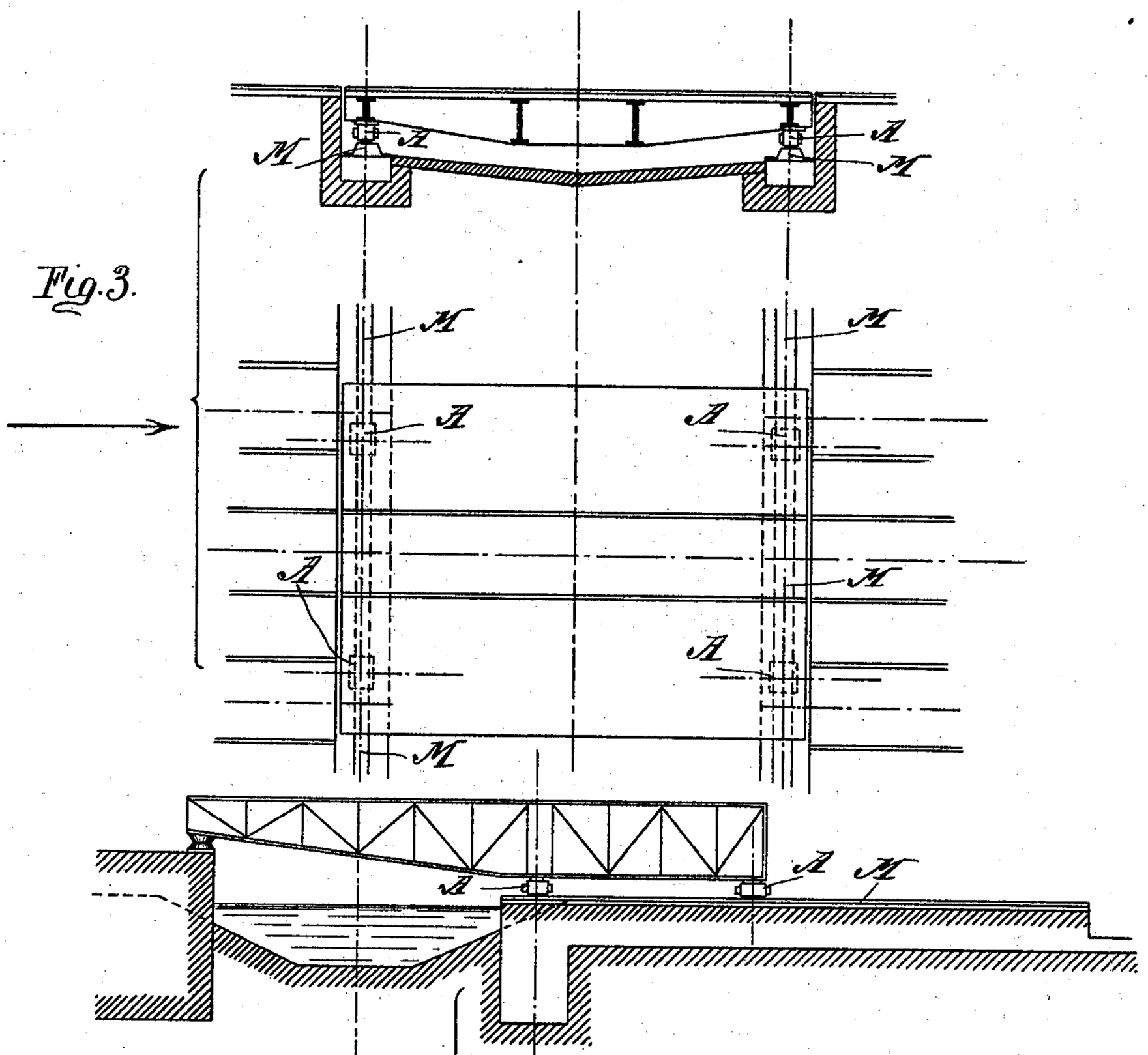
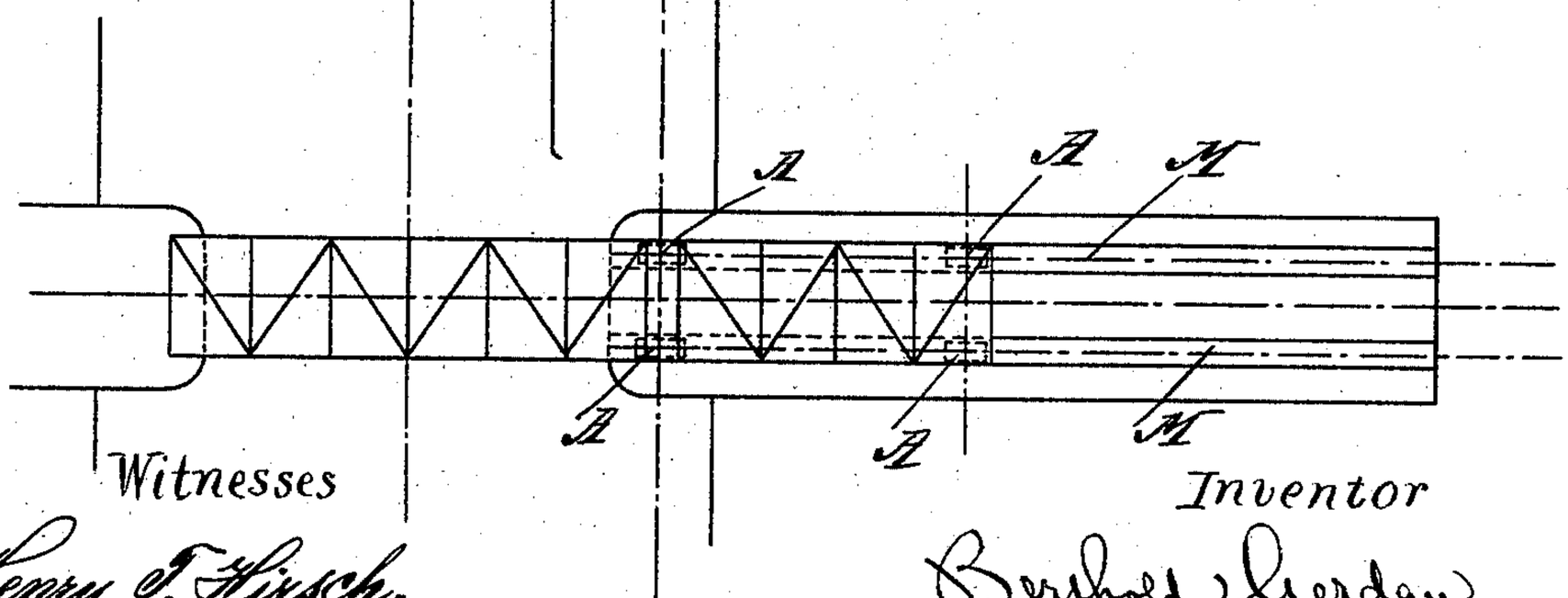


Fig. 4.



Witnesses
Henry T. Hirsch.
M. F. Boyle

Inventor
Berthold Gerdau
By Thomas Drew Stetson
Attorney

(No Model.) 4 Sheets—Sheet 3.

B. GERDAU.

APPARATUS FOR SUPPORTING LOADS.

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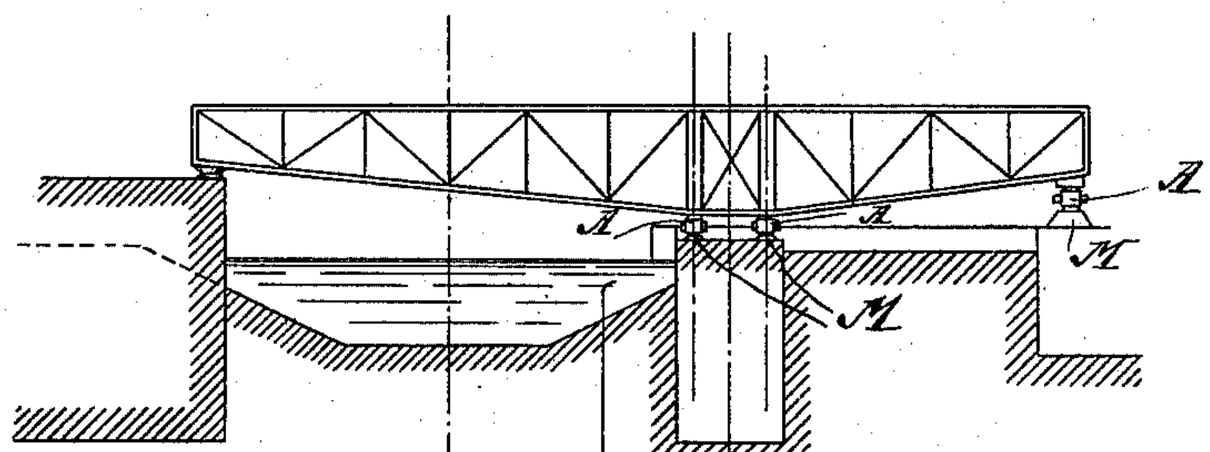

Fig. 5.

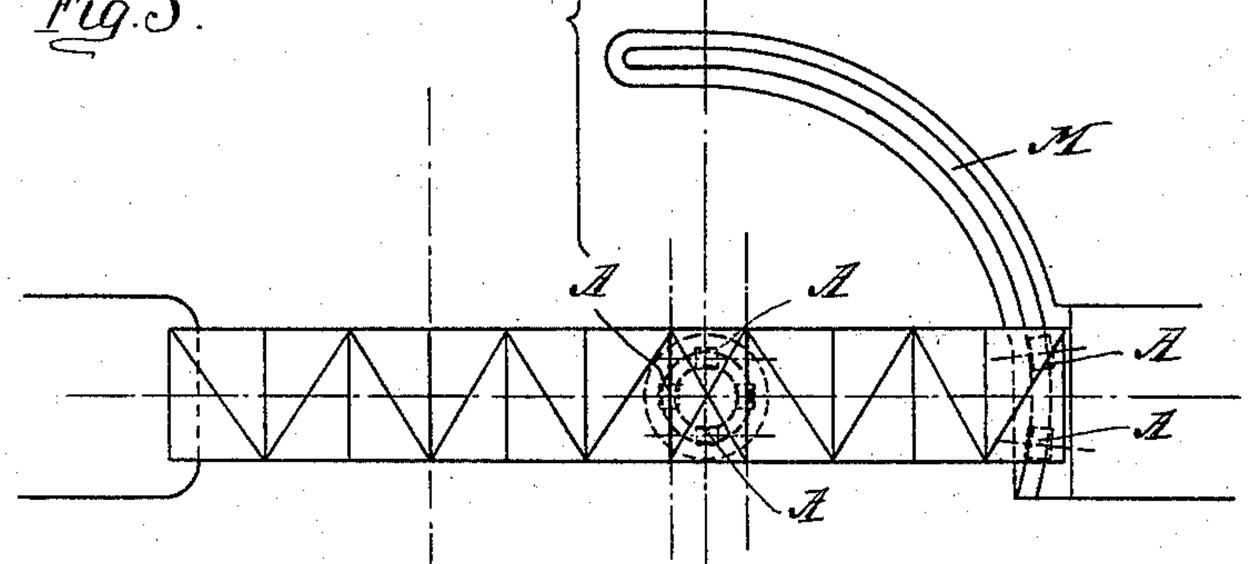

Fig. 6.

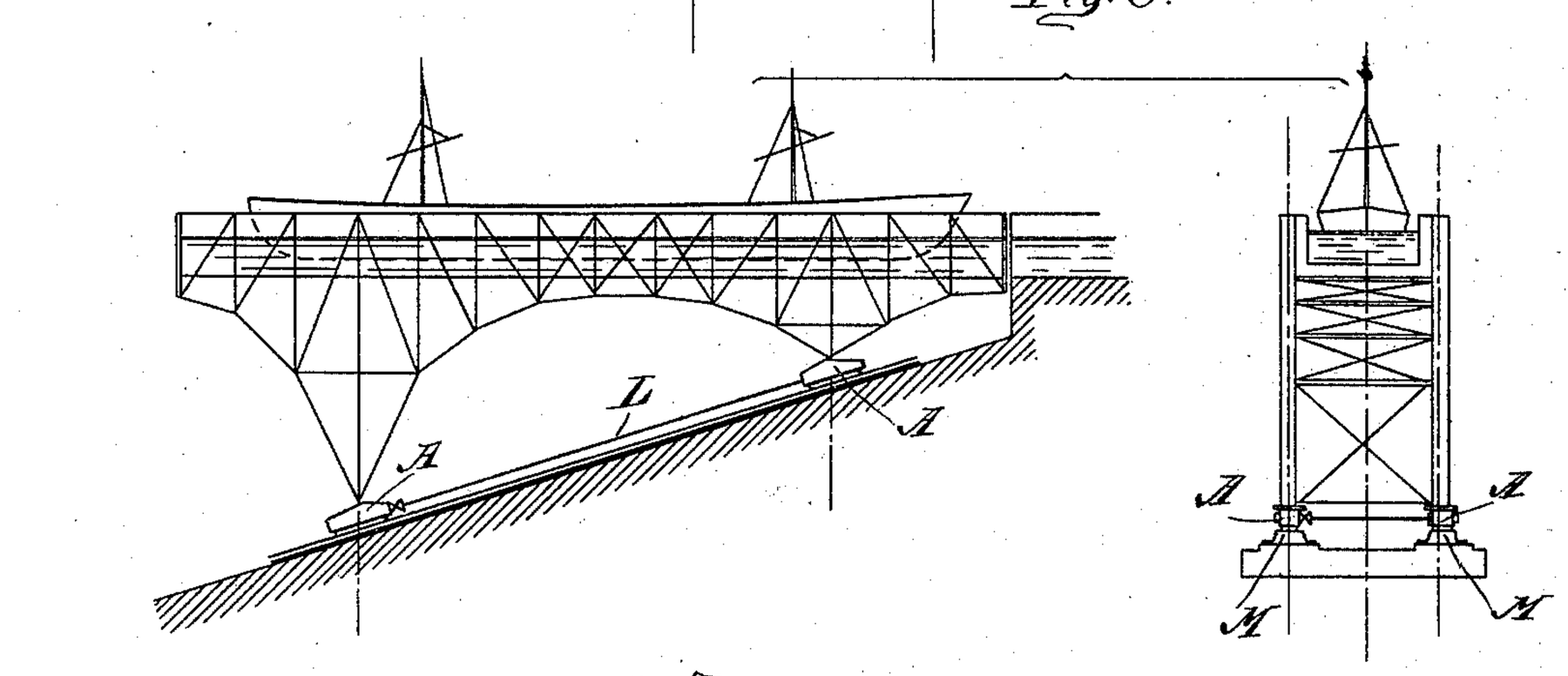

Fig. 7.

Witnesses
Henry T. Hirsch.
M. F. Boyle

Inventor
Berthold Gerdau
By Thomas Drew Stetson
Attorney

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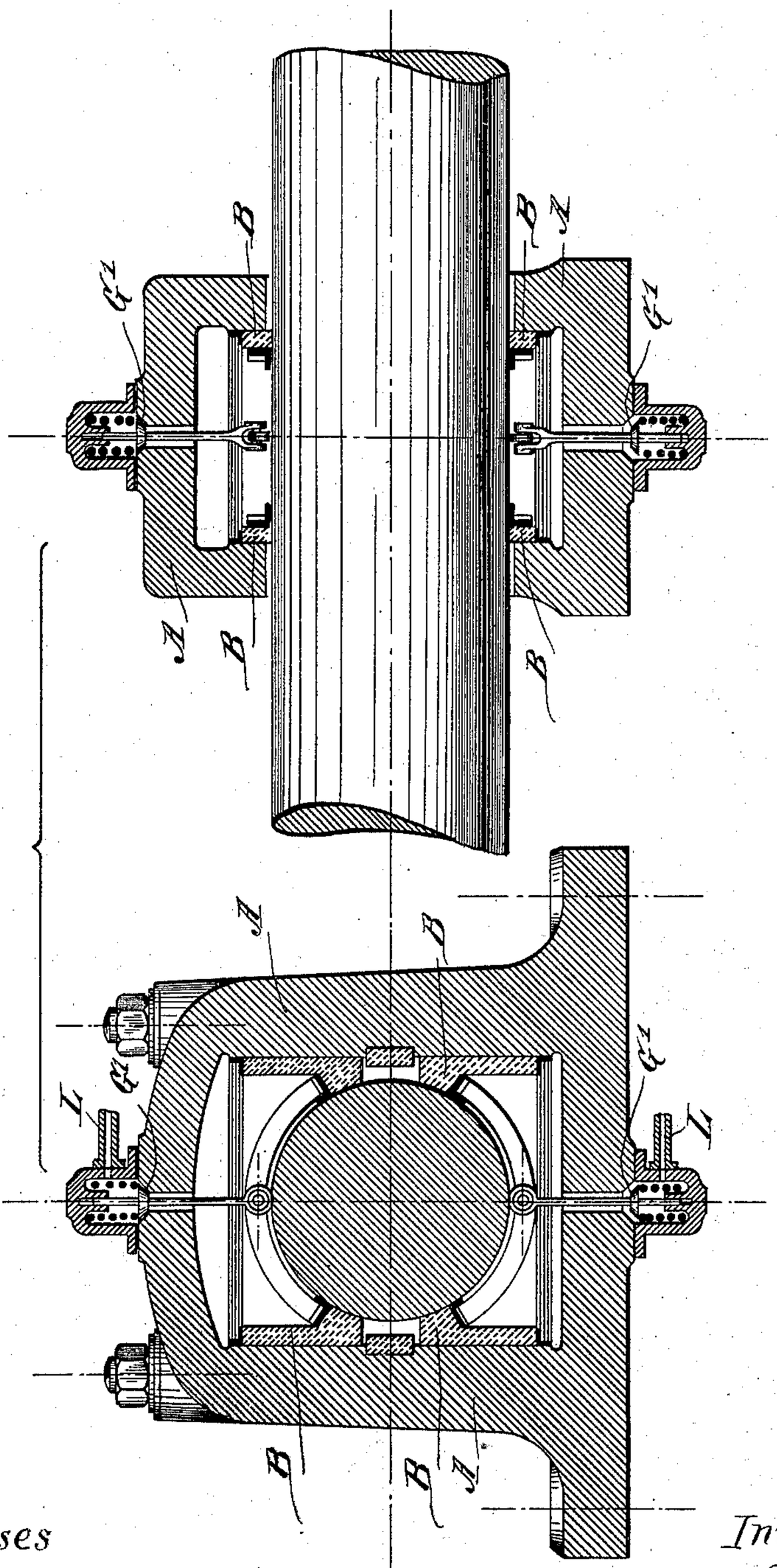
Fig. 8.



Witnesses

Henry T. Hirsch.

M. F. Boyle

Inventor

Berthold Gerdau

By Thomas Drew Stetson

Attorney

UNITED STATES PATENT OFFICE.

BERTHOLD GERDAU, OF DUSSELDORF, GERMANY.

APPARATUS FOR SUPPORTING LOADS.

SPECIFICATION forming part of Letters Patent No. 591,076, dated October 5, 1897.

Application filed April 23, 1897. Serial No. 633,430. (No model.)

To all whom it may concern:

Be it known that I, BERTHOLD GERDAU, a subject of the Emperor of Germany, residing at Dusseldorf, Kingdom of Prussia, in the German Empire, have invented a certain new and useful Improvement in Apparatus for Supporting Loads, of which the following is a specification.

There are conditions, eminently some connected with the supporting and moving of ships, bridges, and other heavy structures, where it is important to have a reliable means of supporting a great weight with absolute stability and with capacity for allowing movement with little frictional or other resistance when required. My invention attains this and allows of being brought into condition for movement and released from such with little labor or delay. I provide a number of short cylinders upon which the weight to be carried is imposed and which are allowed to rest by peculiarly-equipped open ends on a surface to which their edges are adapted and introduce water or other fluid under high pressure into the spaces thus inclosed. I will describe the device, first and mainly, as having the cylinders adapted to lift and made with the lower edges plane, and in such case each should rest and travel on a plane surface. The surface may be inclined. For ordinary uses of my invention the cylinders need have but little length. I provide for giving a nearly free rising and descending motion, but only to a limited extent. I provide means for automatically admitting or excluding the fluid, so as to maintain a just sufficient pressure to carry the load or the portion thereof which rests on any individual support at the proper height.

The accompanying drawings form a part of this specification.

Figure 1 is a central vertical section through one of the cylinders and its immediate connections. The remaining figures are on a smaller scale. The designation Fig. 2 refers to a central section and a plan view showing four of my supports arranged to run in a circular way under a turn-table. The designation Fig. 3 refers to a vertical section and a plan view of a carrying-table for a railway provided with four of my supports. The vertical section is on the horizontal dotted line shown in the plan. Fig. 4 is a vertical section and a plan view of a sliding bridge having four of my supports. The vertical section is on the horizontal dotted line shown in the plan. Fig. 5 is a vertical section and a plan showing six of my supports employed in connection with a swing-bridge. In this four of the supports are run on a circular way near the center of motion of the bridge and two of them run on a way which forms an arc of a larger circle concentric thereto. Fig. 6 is a side elevation and an end elevation showing four of my supports mounted under a ship-lift. Fig. 7 is a side elevation, showing a greater number under a railway less inclined, adapted for taking vessels out of the water for repairs; and Fig. 8 shows two views of the invention as applied for a shaft bearing both vertical sections, the first being in a transverse and the second in the central longitudinal plane.

Similar letters of reference indicate corresponding parts in all the figures where they appear.

Referring to Fig. 1, I employ a strong vessel A, having a smoothly-finished chamber in its interior, which for most purposes may be circular. I will refer to this feature of the apparatus as a "cylinder," although it may be understood that other forms than cylindrical may be used, if preferred, so long as the interior is smooth and is provided with corresponding interior parts, one of which I will now term an "annular piston," and is equipped for restraining the motion, as will appear farther on.

B is the annular piston, formed with a wide offset *b* on its outer edge, which matches to a corresponding offset *a* in the cylinder. The contact of these offsets restrains the extent to which the annular piston may be moved upward into the hollow interior of the cylinder under any circumstances. There is another narrower offset *b'* below, which restrains the sinking of the piston, as will be explained below.

C is a packing of stout leather or other suitable material, adapted to close the joint between the piston B and the smoothly-finished interior of the cylinder A. It is held in place by a metal ring D, kept by bolts tapped into the upper edge of the annular piston.

E is a corresponding packing backed by a corresponding ring F and held by bolts tapped into the inner face of the lower portion of the annular piston extending around and guarding the joint between the lower edge of the annular piston and a stout plane bed or floor M, on which the support is carried.

I provide for keeping the interior of the cylinder supplied with water or other fluid under pressure from a single pump or reservoir, (not shown,) from which it may be received through a corresponding number of branch passages at a pressure a little above that at which it is required.

I will designate the fluid as "water." It will be understood that there may, for use in cold climates, be a sufficient proportion of glycerin mingled therewith to avoid freezing and to give a somewhat lubricating character to the water. I will designate as a "pipe" A^2 the portion of the receiving-passage immediately adjacent to the valve-chamber A'. The more distant portions of the passage should be sufficiently stout hose. There may be a number of the supports associated to carry a single load, as a bridge, turn-table, or ship. They may be all of the same size or may vary indefinitely.

Confining attention to the single one of the supports represented in Fig. 1 the valve-chamber A', properly equipped to endure a high pressure of the water, is provided with a valve G', fixed on a vertical stem G, which is allowed to move up and down to a sufficient extent through a stuffing-box A^3. Its lower end is forked and carries a freely-turning roller H, which bears on the surface M. A spring A^5, secured to the base of the valve-chamber, presses the stem G downward and holds the valve G' tightly to its seat except as it is held up by the contact of the roller with the supporting-surface M. Water at a pressure somewhat in excess of that required to carry the load, being received when needed through the pipe A^2, flows through the partially-opened valve and fills the interior of the cylinder A, exerting a pressure downward upon the inclosed portion of the surface of the floor M and upward in the interior of the cylinder, the latter pressure being effective in raising and supporting the load. When the upward pressure of the fluid thus received exceeds the weight of the load, the cylinder A commences to rise, but the annular piston B remains as before, with its lower edge resting gently on the surface of the floor. As the cylinder rises, carrying upward with it the valve-chamber A', the valve G' is gradually closed and the reception of water from the higher pressure in the pipe A^2 is restrained, the packing-rings C and D performing their functions of making approximately tight joints, and the load carried thereon is held up on the mass of imprisoned water and can be moved laterally in any direction by a comparatively moderate force. Any leakage of the water past the packing and any escape of water by permeating the surface M will allow the sinking of the cylinder A. Such motion, through the action of the roller H on the surface M, results in relatively raising the rod G, and thus increasing the space between the valve G' and its seat and allowing more water to be received. Thus unless the escape of water is so rapid as to exceed the capacity of the supply the device maintains its position with the cylinder supported at a certain predetermined height above the floor M.

A^4 is a strong ring of iron or other suitable material, which I term a "shoe," fixed under the lower edge of the cylinder A. It is wider than the edge of the cylinder and performs the double function of engaging under the offset *b'* on the exterior of the annular piston B, and thus retaining the piston under all conditions and of forming a shoe on which the cylinder will rest upon the floor M, when it is allowed to sink sufficiently.

K indicates the connection of a stop-cock operated at will, through which the water can be discharged from the interior of the cylinder whenever it is desired, and the reception of further actuating water through the pipe A^2 being arrested by a cock I, also controlled at will, the cylinder and its load will sink down until the load is supported on the annular piston B by means of the offsets *a b* or on the shoe A^4, or distributed on each according as the shoe is made thicker or thinner, as will be obvious. I will describe it as resting upon the shoe.

J is a key which serves to hold the axis of the roller H properly engaged with the rod G. These parts should be set so that the roller will run properly in the direction in which my support and its load are required to be moved.

The invention is applicable to apparatus for supporting a great variety of stationary or movable loads. It is eminently adapted to serve where it is desired that the support shall be sometimes stationary and at other times requires to be easily moved. The first condition is attained by shutting off the access of more water and opening the stop-cock K and allowing the water in the hollow cylinder to escape. Thus adjusted the load rests fairly and rigidly by the contact of the piston B or shoe A^4, or both, on the floor M. The second condition is attained by simply closing the stop-cock K and opening again the other stop-cock I and admitting the actuating water, which must be supplied under the required pressure, restrained only by the automatic valve G', to raise the cylinder and its load to the moderate height required, as first described.

L are pipes, which may be of metal, curved so as to spring, or made with well-packed slip-joints, so as to expand and contract in length to allow for imperfections in adjustment or for springing or yielding of the parts under varying strains. They provide a free com-

munication between the interior of the several cylinders A. When thus prepared, there will still be use for an independent automatic valve G′ and a corresponding actuating-roller H for each, but one admission-valve I and one discharge-valve K may serve for the whole.

In the turn-table at Fig. 2 the supporting-cylinders are arranged beneath the turn-table S and slide upon a circular path having a sufficient breadth to serve as the plane floor M. The construction is the same as described with reference to Fig. 1. Fluid-pressure being forced into the hollow cylinder A by a pump (not shown) which is connected with those by means of a supply-pipe, the turn-table is thereby released and rests upon the columns of pressure fluid. It is then turned and the stop-cock K being opened, allowing the pressure-fluid to escape, the turn-table rests again upon the shoes A^4.

With traveling platforms, as shown in Fig. 3, my carrying devices can be so arranged under the platform that they rest upon parallel ways M. The platform is moved along after the cylinders A have been raised, and when brought into position the fluid-pressure is allowed to escape.

A similar arrangement is shown in the sliding bridge in Fig. 4. In this case there are provided on the one shore parallel ways M, extending in the direction toward the opposite shore, on which ways my supports for the bridge slide. The working of the sliding bridge is similar to that of the traveling platform.

In the application of the invention to a swing-bridge, Fig. 5, my supports are arranged symmetrically around the pivot or axis of the bridge-body, so as to slide upon a circular way M. The end of the swing-bridge which turns over the land also carries two of my supports, which slide, but with less load, upon the curved way M′. The working of the swing-bridge is the same with the turn-table, Fig. 2.

In the raising apparatus, Fig. 6, ships which have entered a lock can be raised, together with the latter, along an inclined way and be thus conveyed from a channel at a low level to one at a high level or lowered from a high level to a low level. The lock is supported upon cylinders A, provided with annular pistons, as above described, made to communicate with each other and resting upon inclined ways M. By this means the lock is provided with a yielding support, the charge of which is maintained at constant pressure, owing to the intercommunication of the cylinders by means of the pipes L, through which any excess or deficiency of pressure that may arise in any cylinder is at once equalized from the other cylinders. The figure shows both a side view and a cross-section of the lock carried on four of my supports. The mode of working with this raising and lowering apparatus is as follows: The lock may be at first in its position of rest at the lower station. Lock-gates (not shown) are opened, and the vessel passes into the lock. The lock-gates are closed again, the pressure-pumps are set in motion, forcing water under pressure into the chambers of my supports until the cylinders A have been sufficiently raised away from the inclined ways M^4, whereupon the lock resting upon the fluid columns in the cylinders A can be moved by any sufficient force up along the inclined ways. Arrived at the upper station the motion of the lock is stopped, and the pressure fluid being discharged from my supports water-tight connection is made between the lock and the upper canal, and, lastly, the proper lock-gate and the corresponding gate in the canal are opened, so that the vessel can pass into the upper canal. A reverse movement carries the same or another vessel down.

Fig. 7 shows a similar arrangement for supporting a ship upon a number of my supports which rest upon a more gently-inclined way M, along which a ship can be raised or lowered. This arrangement can be applied either on ship-railways or for conveying ships into or from docks for effecting repairs.

Fig. 8 shows the application of my cylinders and substantially annular pistons and packings and automatic controlling means adapted to serve as a bearing for a heavy shaft or for trunnions and the like. There are two sets, one above and one below. The edges of the cylinders and the pieces which correspond to the annular pistons in the other forms are not plane, but are contorted to match to the adjacent surfaces of the shaft M^5. In this form the parts A^6 A^7, which correspond to the cylinder A of my first plane form, are always stationary. The shaft M^2, corresponding in a proper sense to the floor M in the plane form, is the portion which moves, and the motion is rotative. It will be also seen that the valves are opened to let the water above and below the shaft, respectively, not by the motions up and down of the cylinders A^6 and A^7, but the motions up and down of the shaft. The principle involved, however, is the same in this as in the previous forms. A cylinder A^6 above and a cylinder A^7 below the shaft are filled with fluid under a sufficient pressure to act as a bearing for the shaft to resist either an upward or downward thrust. In many cases, however, only a lower supporting-chamber may be required. The housing or lower bearing A^7, as also the binder or cover A^6, contains hollows or chambers in which are the contorted pistons B^3, which are fitted fluid-tight both against the shafting and also against the housing and cover by means of suitable similarly-contorted packing C D. The previously-described valve G′ is provided in the valve-chamber for the upper bearing and one reversed for the lower bearing. A roller H for each runs on the smooth surface of the shaft, the upper valve opening upward and the lower valve opening downward, with the

effect that the shaft which performs the rôle of the support M in the previous figures will always be held in the same position. When the shaft sinks, the lower valve will open automatically, so that the pressure fluid will enter the chamber A^8 below the shaft from the supply-pipe A^3 and will raise it again. In the same way any change in position in an upward direction will be prevented by the admission of more of the pressure fluid in the binder A^6 above the shaft.

In all the constructions the same letters of reference indicate the same parts, distinguished, when necessary, by supernumerals.

Other modifications may be made in the forms and proportions. There may be a greater or less number of supports. They may be each equipped with independent means of supplying water under pressure. The pressure may vary under different conditions or may be varied in different supports applied to a single ship or other object. The forms may be varied. The stout castings A may be square, oblong, or of various other forms, the hollow pistons B having a corresponding outline. I prefer for such cases that the cylinders shall be not only so called, but shall be actually cylinders, and that the open-centered pistons, which I have termed "annular," shall be actually circular.

Instead of the two parts A^6 and A^7 being in separate pieces, as indicated by the thin angular line in Fig. 8, these parts can be made in one single casting with the effect to give increased firmness and strength, but such construction would involve difficulties in boring and otherwise finishing the hollow interior of each part and in introducing and adjusting the annular piston and packages therein and would also involve difficulties in applying the parts upon the shaft and removing them in case repairs became necessary.

The area of the space within the lower packing E where the water is allowed to press on the surface M may be greater or less than shown, correspondingly modifying the tendency of the water to hold the annular piston B and its attached packings down when the cylinder A rises.

I claim as my invention—

1. In a supporting device of the class described, a hollow cylinder with valves for admitting and discharging water under pressure, said cylinder being formed with an internal offset, in combination with an annular piston B, formed with an external offset adapted to bear the load, and arranged to serve therewith, substantially as herein specified.

2. In a supporting device of the class described, a hollow cylinder, an annular piston fitting easily therein, a supply for admitting water under pressure, a valve for said supply, a rod for automatically changing the adjustment of the valve as the position of the cylinder and piston relatively varies, and a wheel or roller H supporting such rod and bucket without friction on the surface M, all combined and arranged to serve substantially as herein specified.

3. In a supporting device of the class described, a hollow cylinder with valves for admitting and discharging water under pressure, an annular piston fitting easily therein, and a shoe A^4 in the bottom of the cylinder for confining the piston, combined and arranged to serve substantially as herein specified.

4. In a supporting device of the class described, a hollow cylinder, an annular piston fitting easily therein, a supply for admitting water under pressure, a valve for said supply, and a spring-depressed roller for normally holding the valve closed but adapted to yield and open the same when the piston moves within the cylinder, all combined and arranged to serve substantially as herein specified.

5. In a supporting device of the class described, a hollow cylinder with valves admitting and discharging water under pressure, an annular piston fitting easily therein, and top and lower inner packing-glands, adjustably connected by rings to the piston, substantially as herein specified.

6. In a supporting device of the class described, a hollow cylinder with valves for admitting and discharging water under pressure, said cylinder being formed with an internal offset, in combination with an annular piston B formed with an external offset adapted to bear the load, and a shoe A^4 in the cylinder-bottom to serve as a rest for the cylinder and to confine the piston, substantially as herein specified.

In testimony whereof I have hereunto set my hand, at Dusseldorf, Germany, this 25th day of March, 1897, in the presence of two subscribing witnesses.

BERTHOLD GERDAU.

Witnesses:

ERNEST ANDRÉ,

WILLIAM ESSENWEIN.