

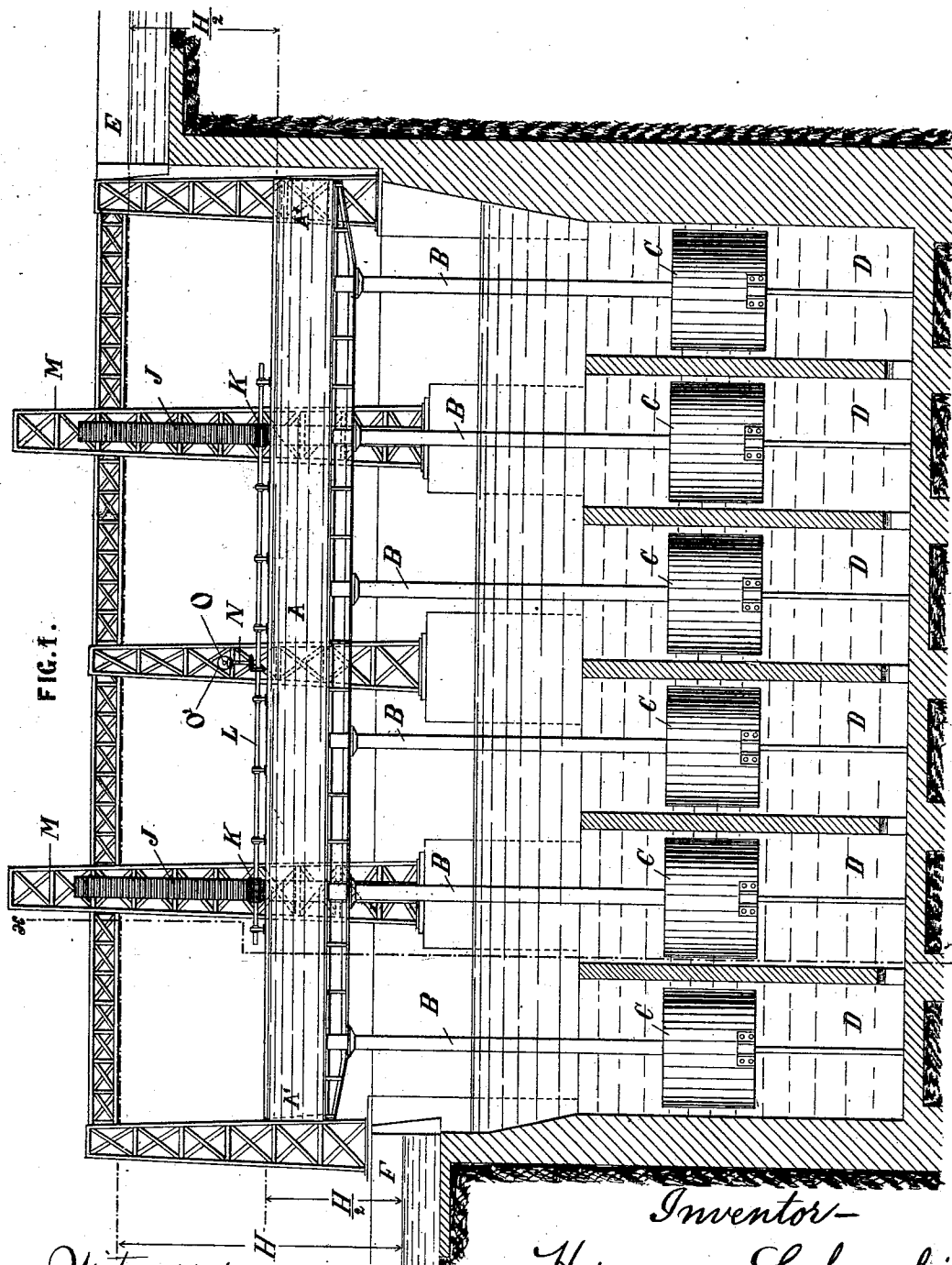
(No Model.)

H. LUBOWSKI.
HYDRAULIC LIFT.

3 Sheets—Sheet 1.

No. 513,800.

Patented Jan. 30, 1894.



Witnesses—
Walter E. Allen.
Edward D. Knight.

Inventor—
Hermann Lubowski.
By *Knight & Co.*
Attorneys.

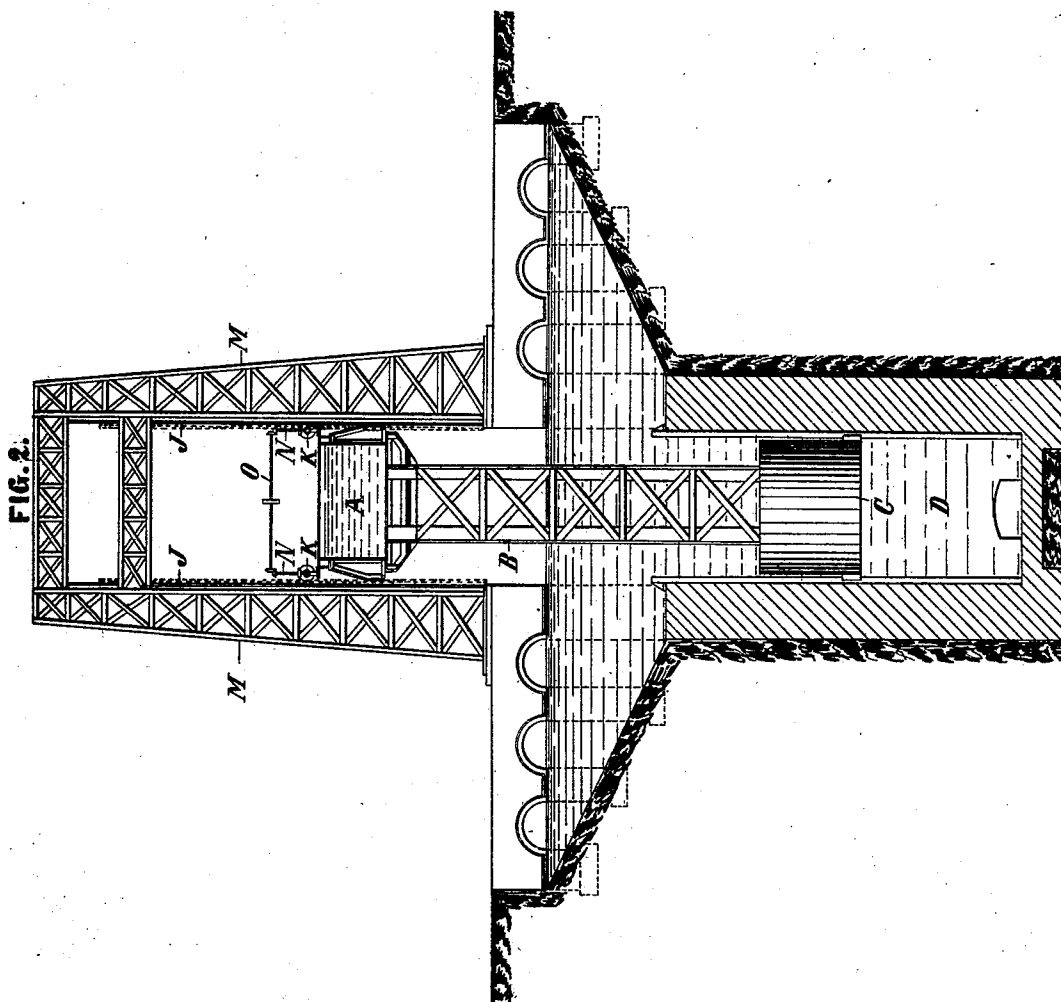
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H. LUBOWSKI.
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3 Sheets—Sheet 2.

No. 513,800.

Patented Jan. 30, 1894.



Witnesses—
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Edward D. Knight.

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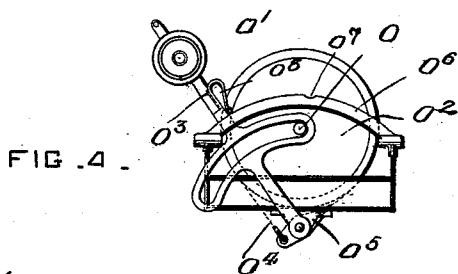
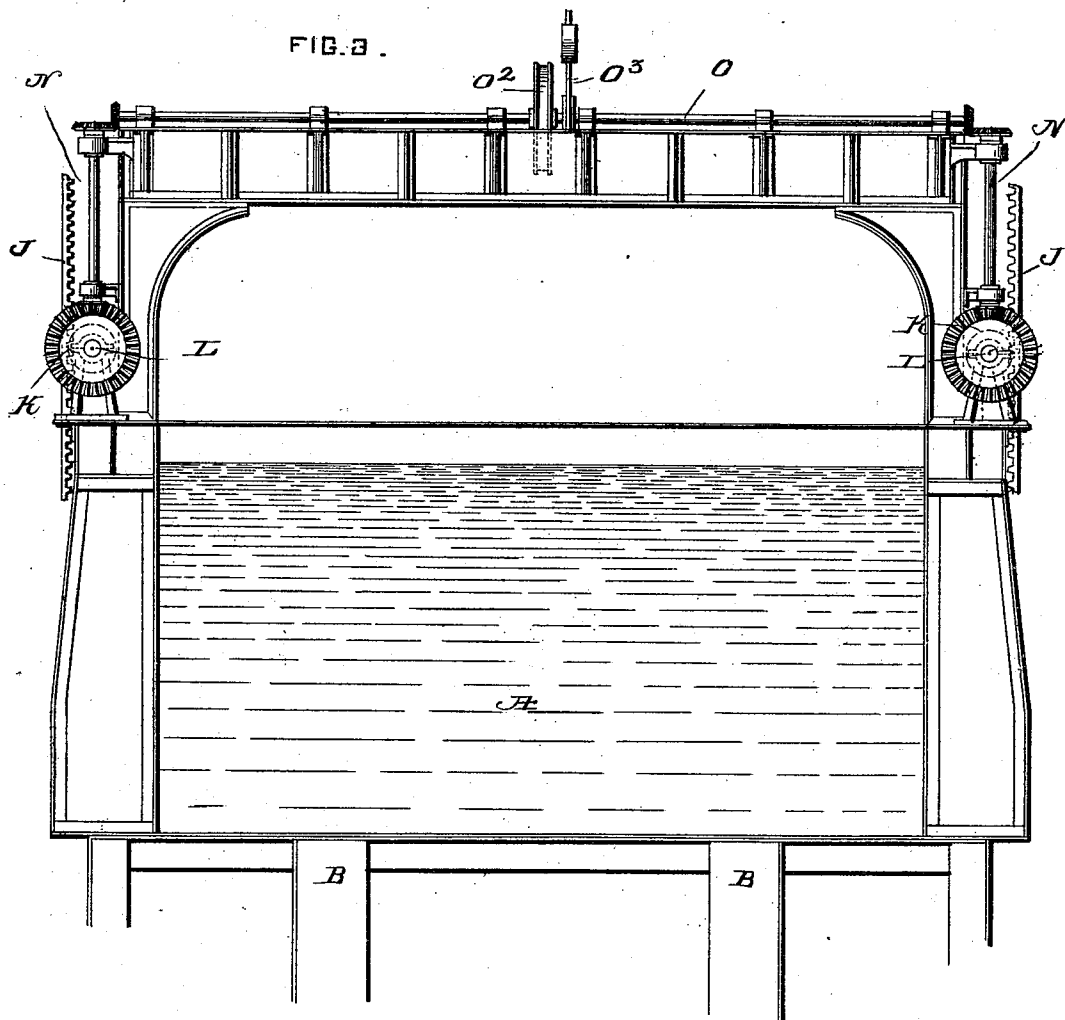
(No Model.)

3 Sheets—Sheet 3.

H. LUBOWSKI.
HYDRAULIC LIFT.

No. 513,800.

Patented Jan. 30, 1894.



Witnesses:
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Inventor:
Hermann Lubowski
By *Knight Bros.*
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UNITED STATES PATENT OFFICE.

HERMANN LUBOWSKI, OF MAGDEBURG, GERMANY, ASSIGNOR TO THE GRU-
SONWERK, OF SAME PLACE.

HYDRAULIC LIFT.

SPECIFICATION forming part of Letters Patent No. 513,800, dated January 30, 1894.

Application filed November 25, 1892. Serial No. 453,124. (No model.)

To all whom it may concern:

Be it known that I, HERMANN LUBOWSKI, a subject of the King of Prussia, and a resident of Magdeburg, in the Kingdom of Prussia, German Empire, have invented certain new and useful Improvements in Hydraulic Lifts, of which the following is a specification.

My invention relates to improvements in lifts and has for its object the construction of a hydrostatic lift for effecting the transfer of vessels between canals or other waters at different levels. The said improved lift is operated by simple means and with but a small expenditure of energy. It is based on the same mechanical principle as that of the pendulum.

In order that the nature of the said invention may be clearly understood it will now be described with reference to the accompanying drawings in which—

Figure 1 is a longitudinal central section of an improved hydrostatic lift constructed according to this invention. Fig. 2 is a transverse section of the said lift on the line $x x$ of Fig. 1. Fig. 3 is a transverse section of the platform or trough on a larger scale. Fig. 4 is a side view of the brake-mechanism.

Similar reference letters indicate corresponding parts throughout the drawings.

A is a platform or trough designed for the reception of the vessel or vessels and arranged to rise and fall between suitable guides, as hereinafter described. The said trough is adapted to be fitted to a proper depth with water and is provided with suitable water-tight gates at its ends A'. This trough is supported upon standards B, which rest upon floats C. The latter are submerged in wells or chambers D' which communicate with each other.

E' is the higher canal and F the lower canal. Both of the said canals are provided with water-tight gates which, with the gates on the trough, control communication between the canals and the trough in the manner hereinafter set forth. The depth of the water in the wells or chambers D' is so adjusted that the trough A does not dip thereinto even when the said trough is in its lowest position. In such lifting apparatus it is an indispensable condition that the trough, during its ascent and de-

scend, be controlled in such a manner that it shall always maintain a horizontal position. In the present example this is achieved by the means now to be described:—Four vertical racks J are firmly secured to guide standards M suitably supported upon the foundations of the structure. Four spur-wheels K, secured to horizontal shafts L supported in bearings on the side of the trough A, engage with the said racks and are geared to each other by the said shafts L the vertical shafts N and the horizontal shafts O and suitable gear wheels fixed on the said shafts. The said spur wheels K are prevented by the aforesaid gearing from rotating otherwise than at equal velocity, so that the four points on the trough at which the said wheels are situated are compelled to move simultaneously and at equal speed and thus the trough is kept horizontal.

Upon the shafts O is arranged a brake or locking device O' by means of which the toothed wheels K are prevented from turning and can be caused to stop the trough at any point in its travel. The brake-mechanism which I have shown consists of a brake-pulley O² secured to the shaft O, a brake-lever O³, a brake-band O⁴, a cross-arm O⁵ secured to the inner arm of the brake-lever, and to which the ends of the brake-band are connected, and a segment-bar O⁶ having notches O⁷, with which the catch O⁸ on the brake-lever engages.

The principle upon which the operation of the lift is based, and the manner in which it is operated will now be described. If the height of the water-level of the upper canal E' above that of the lower canal F is designated by H, the buoyancy of the system consisting of the trough A, the standards B and the floats C, is so balanced by the weight of water in the trough A that the said system will be in equilibrium when the water level of the trough is exactly midway between that of the upper canal and that of the lower canal, that is to say at a distance from either which is represented by the fraction $\frac{H}{2}$. In this case it is immaterial whether a large or small laden or light vessel or no vessel at all is in the trough, provided only that the water in the trough is at the same level in any of such instances. Let it be supposed that the said system is moved downward from this po-

sition of equilibrium so that the surface of the water in the trough comes to the same level as that of the canal F, and that the system is held in its new position. Then there will no longer be equilibrium between the buoyancy and the weight of the system but the former will exceed the latter by the increased hydrostatic pressure upon the floats in their lowermost position and also by the weight of the quantity of water displaced by the increased immersion of the standards B which are deeper in the water by the distance represented as aforesaid by $\frac{H}{2}$ or one-half of the range of vertical movement of the system. Accordingly the system if it be now released, will have a tendency to rise again, the motive power being the said excess buoyancy the said system passing upward past the point of equilibrium, the momentum aiding and supplementing the diminishing buoyancy of the floats which continues to be, somewhat, throughout the entire lift. This gradually decreasing motive power imparts to the mass of the system, which remains constant, an increasing velocity with a diminishing acceleration the former becoming a maximum at the aforesaid midway point. Arrived at the said point the system has acquired momentum which moves it still farther upward, but at a diminishing velocity, because the standards B move farther and farther out of the water in the wells or chambers D' and the buoyancy of the system therefore diminishes. When the trough has risen so far that the surface of the water therein arrives at the same level as that of the water in the upper canal, and when the said surfaces are thus coincident, the momentum of the system is entirely expended. The trough, therefore, at its highest position has no velocity, and would immediately return downward like a stone thrown up into the air, or like a pendulum which has reached the highest point of its vibration, if it were not held. The retention of the system in its highest position, when its momentum is *nil*, is easily effected by applying the brake to prevent the rotation of the spur wheels K. The trough when it arrives at its highest position is placed in water-tight connection with the end of the upper canal and after the gates of the canal end and of the trough are opened a ship raised by the trough can move into the canal, or a ship to be lowered from the latter can move into the trough. After the gates have been closed again the system is liberated by disengaging the brake or locking device, and it sinks at an increasing velocity to the middle position, and thence, by overcoming the increasing buoyancy, at a decreasing velocity to the lowest position, in which it arrives with no velocity. Here the brake is again applied or the locking device engaged, and the trough held so that ships may pass between it and the lower canal.

From the foregoing it will be seen that the mode of operation of the apparatus is based upon the movement of the system about the

middle position of equilibrium to the two limits of the amplitude of its oscillation, that is to say the surface level of the lower and of the upper canal, and the movement of the system is imparted thereto by the excess of the buoyancy possessed by the system when it is below the said middle position and by the excess of the weight of the system over its buoyancy when it is above the said middle position.

Theoretically the apparatus would not require the expenditure of energy either for the raising or for the lowering of the same, but in practice, as frictional resistances exist, such as the resistances in the water, in the air and in the guides which may be assumed as constant the trough will have to be loaded a little more in its upper position and a little less in its lower position. This may readily be accomplished by fixing the trough, even before the system has completely reached its limits of oscillation. In the highest position a little water always flows into the trough from the upper canal which water, in the lowest position of the trough flows off into the lower canal. Should the water level of the upper or lower canal change this circumstance may be taken into account in a simple manner in the case of the described apparatus. The position of equilibrium of the system then requires only to be placed somewhat higher or lower, in order that the lift may continue to act properly, and this may be attained by a slight change in the quantity of water in the trough.

Having described this invention, what I claim, and desire to secure by Letters Patent, is—

1. In operating canal lifts supported upon buoyant bodies to stand in equilibrium at a point between their upper and lower levels, the method which consists in releasing the lift from either of said levels, permitting it by gravity or buoyancy, as the case may be, to pass to the equilibrium point and past the latter by remaining buoyancy and acquired momentum, to, or near to, the opposite level, as set forth.

2. In operating canal lifts supported upon buoyant bodies to stand in equilibrium at a point between their upper and lower levels, the method which consists in releasing the lift from either of said levels, permitting it by gravity or buoyancy, as the case may be, to pass to the equilibrium point and past the latter by remaining buoyancy and acquired momentum to, or near to, the opposite level, aiding the said oscillation to its completion by suitable power appliance and locking the lift upon such completion, as set forth.

3. The combination, with a low level and a high level; of a platform having a buoyant support by means of which it is sustained in equilibrium in a position between the low level and the high level, and means for locking the platform at the terminal points of its travel; whereby the platform may move down-

ward from the high level to the point of equilibrium by gravitation and past said point by its momentum to the low level where it is locked, and when released spring upward by its buoyancy and past its point of equilibrium to the high level; substantially as described.

in equilibrium in a position between the low level and the high level, and a brake mechanism by means of which the platform is locked at the terminal points of its travel; substantially as described.

HERMANN LUBOWSKI.

Witnesses:

KARL E. DETZNER,
EMIL KALLNECKER.

4. The combination, with a low level and a high level; of a platform having a buoyant support by means of which it is sustained