(No Model.)

A. P. HAAG & F. J. FRIEDRICH.

MACHINE FOR STORING WAVE POWER.

No. 594,078. Patented Nov. 23, 1897.

Fig. 2.

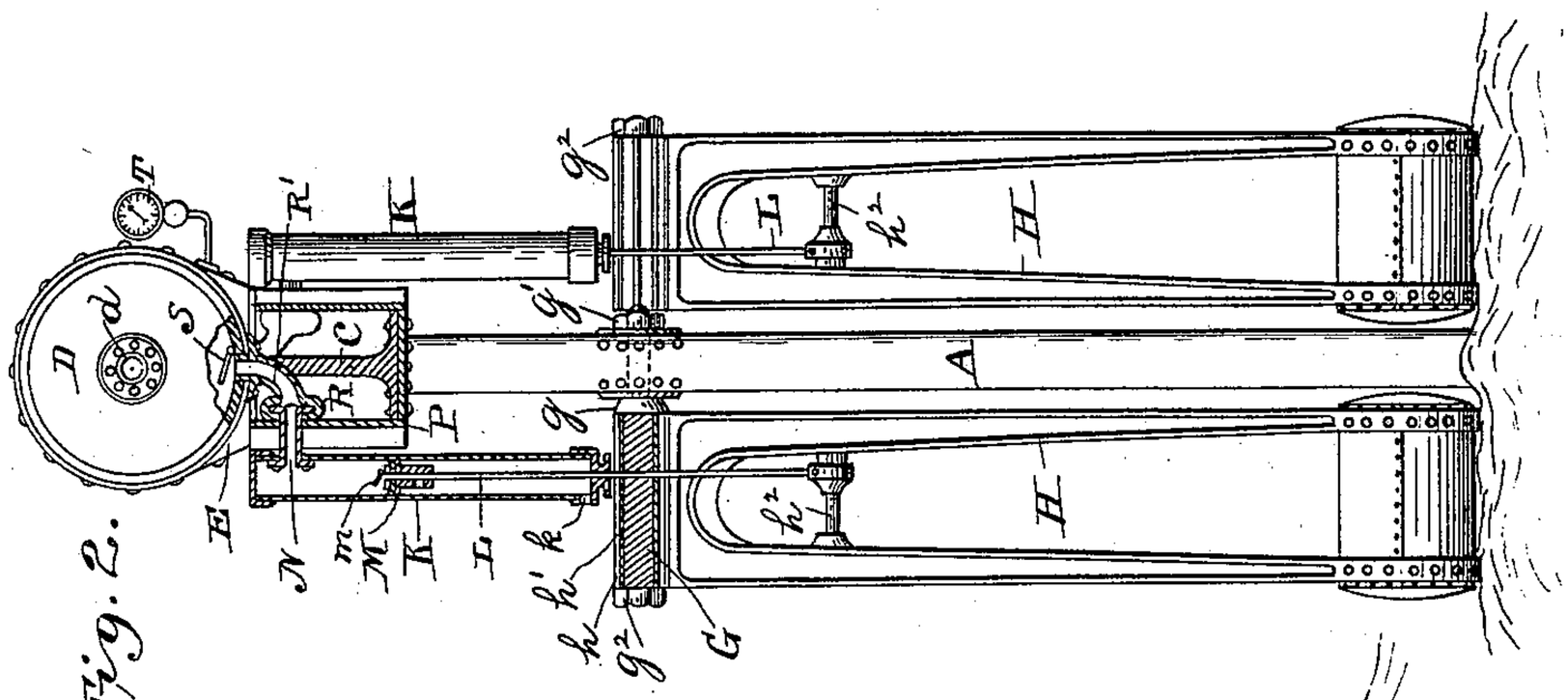
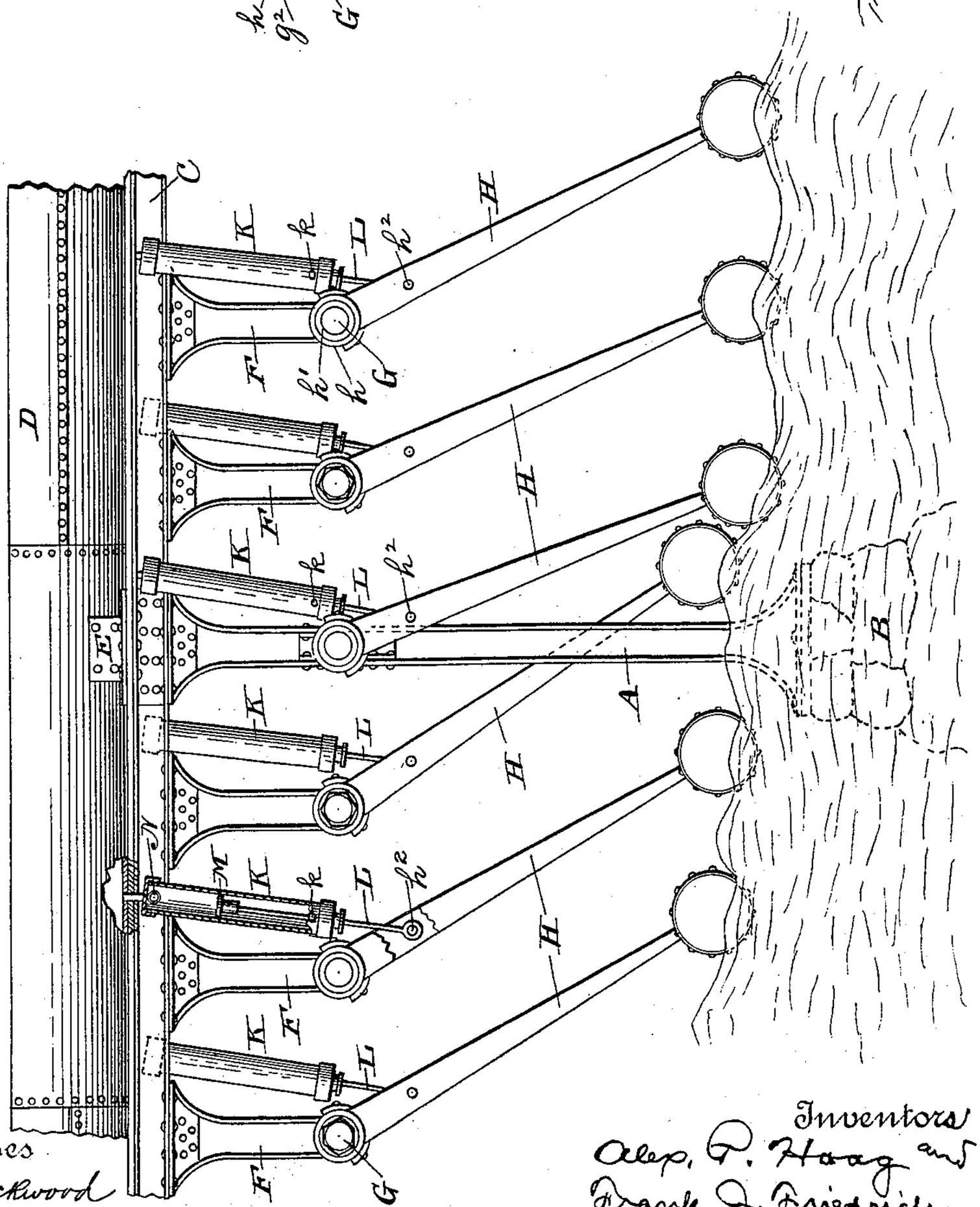


Fig. 1.



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UNITED STATES PATENT OFFICE.

ALEX P. HAAG AND FRANK J. FRIEDRICH, OF FALL RIVER, MASSACHUSETTS, ASSIGNORS OF ONE-THIRD TO JOHN L. WIENER, OF SAME PLACE.

MACHINE FOR STORING WAVE-POWER.

SPECIFICATION forming part of Letters Patent No. 594,078, dated November 23, 1897.

Application filed February 25, 1897. Serial No. 624,984. (No model.)

To all whom it may concern:

Be it known that we, ALEX P. HAAG, a citizen of Austria-Hungary, and FRANK J. FRIEDRICH, a citizen of Germany, residing at Fall River, in the county of Bristol and State of Massachusetts, have invented certain new and useful Improvements in Machines for Storing Wave-Power; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

Our invention relates to machines for storing the power developed by the vertical movement of waves, either of the ocean, lakes, or rivers. Many devices for this purpose have been proposed, but we believe that ours is novel, simple, and efficient.

It consists of one or more air-pumps pivotally suspended from a strong frame, an air-receiver communicating with said pump or pumps, and a swinging float connected directly with the piston-rod of each pump and adapted to be swung to and fro and up and down by the waves.

In the drawings, Figure 1 is a side elevation of a portion of a machine embodying our invention. Fig. 2 is a vertical sectional elevation.

A suitable number of strong columns A are erected on solid foundations B. We prefer to use metallic columns, as shown, though wooden piles may be employed, if desired. On a row of such columns, extending out into the water in a line with the normal direction of the waves, we lay a girder C, preferably an I-beam with wide flanges. Along the top of this girder we secure an air-receiver D, preferably a cylindrical tube of cast or sheet metal, resting in chocks E. It may be large enough to serve as a reservoir for storing a quantity of compressed air. At suitable intervals along the girder are bolted hangers F, in the lower ends of which is a transverse hole to receive a horizontal pivot-stud G, projecting from one side. We prefer to make this stud with a collar g to bear against one side of the hanger and a screw-threaded portion to carry a nut g', which can be tightened against the other side of the hanger. The outer ends of the studs are screw-threaded to receive retaining-nuts g^2. The studs project alternately to the right and to the left. The columns A also have studs G like the hangers. Levers H are provided at their upper ends with long eyes h, which fit on the studs G and preferably have a lining or bushing h' of Babbitt metal or the like. The nuts g^2 retain the levers in place and allow them to swing freely on the studs. The levers are preferably bifurcated, as shown, and at their lower ends is secured a float I, preferably a water-tight metallic drum, as shown. Adjacent to each hanger is an air-pump cylinder K, the several cylinders being arranged alternately on opposite sides of the girders, similarly to the levers H. The piston-rods L are connected directly with the levers H, being preferably pivotally attached to transverse bars h^2 between the legs of the levers.

At or near the lower end of the cylinder K is an air-inlet port k. The piston M has a port through it, with a downwardly-closing check or flap valve m. The upper end of the cylinder is provided with a hollow trunnion N, by means of which it is supported and on which it can swing. The trunnion is journaled in a bearing in a plate P, bolted to the girder C, and its end is received in a union R, which forms the end of a short delivery-pipe R', communicating with the receiver or reservoir D. A check-valve S retains the air in the reservoir, the pressure being shown by a gage T. At any suitable place on the reservoir there is a connection d for the attachment of a distributing-pipe, by means of which the air compressed in the reservoir can be led off to motors or other power-translating devices.

The operation of our machine is as follows: The floats swing up and down as the waves successively pass under them, rocking the levers and reciprocating the piston-rods. The pivotal mounting of the pump-cylinders permits them to swing freely with the movement of the levers, and the air compressed by the pistons passes through the hollow

trunnions to the reservoir. By using a large number of air-pumps it is possible to keep the air-pressure up to a high point unless the water is perfectly quiet; but even the swell of the ocean, which is always present even on a calm day, is sufficient to keep the pumps at work.

Our invention has but few parts, with no complicated valve motion to get out of order. The rising and falling of the tide does not interfere with the proper operation of the levers provided the parts are properly proportioned.

Having thus described our invention, what we claim is—

1. In a machine for storing wave-power, the combination with an air-receiver, of one or more air-pumps each mounted on a trunnion, and one or more levers each carrying a float and connected directly to the piston-rod of one of said air-pumps, each lever being fulcrumed on a different axis from that of its pump-trunnion, substantially as described.

2. In a machine for storing wave-power, the combination with an air-receiver, of one or more air-pumps, each mounted on a hollow trunnion opening into the pump-cylinder and communicating with the air-receiver, a lever connected directly with the piston-rod of each pump, and a float on the end of said lever, substantially as described.

3. In a machine for storing wave-power, the combination with supporting-columns, of a girder thereon, a tubular air-receiver mounted on said girder, a plurality of air-pumps, each pump-cylinder having a hollow trunnion journaled in a bearing in said girder, and opening into the cylinder, a pipe connecting said trunnion with the air-receiver, a check-valve controlling said pipe, a lever pivotally supported from the girder adjacent to each cylinder, and connected directly with the piston-rod of the pump, and a float on the end of the lever, substantially as described.

4. In a machine for storing wave-power, the combination with the girder of a series of hangers secured thereto, a horizontal stud at the end of each hanger, a lever pivoted on said stud, a float on the end of the lever, an air-pump actuated by the lever, and an air-receiver, substantially as described.

5. In a machine for storing wave-power, the combination with a girder, of a series of hangers secured thereto, a horizontal stud on the end of each hanger, said studs projecting alternately to right and to left, bifurcated levers each having a long eye pivotally mounted on a stud, an air-tight drum secured to legs of the lever, a transverse bar between said legs, and an air-pump on a trunnion adjacent to each hanger, and having its piston-rod connected directly to said bar, substantially as described.

6. In a machine for storing wave-power, the combination with columns A, of girders C, air-reservoir D, hangers F secured to said girder and carrying studs G, bifurcated levers H having eyes *h* fitting said studs, floats I secured to said levers, cylinders K having air-inlet ports *k*, pistons M having check-valves *m*, piston-rods L connected directly with the levers H, hollow trunnions N opening into the cylinders and journaled in a plate P secured to the girder, unions R and pipes R′ connecting said trunnions with the air-reservoir D, and check-valves S controlling said pipes R′, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

ALEX P. HAAG.
FRANK J. FRIEDRICH.

Witnesses:
ARBA N. LINCOLN,
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