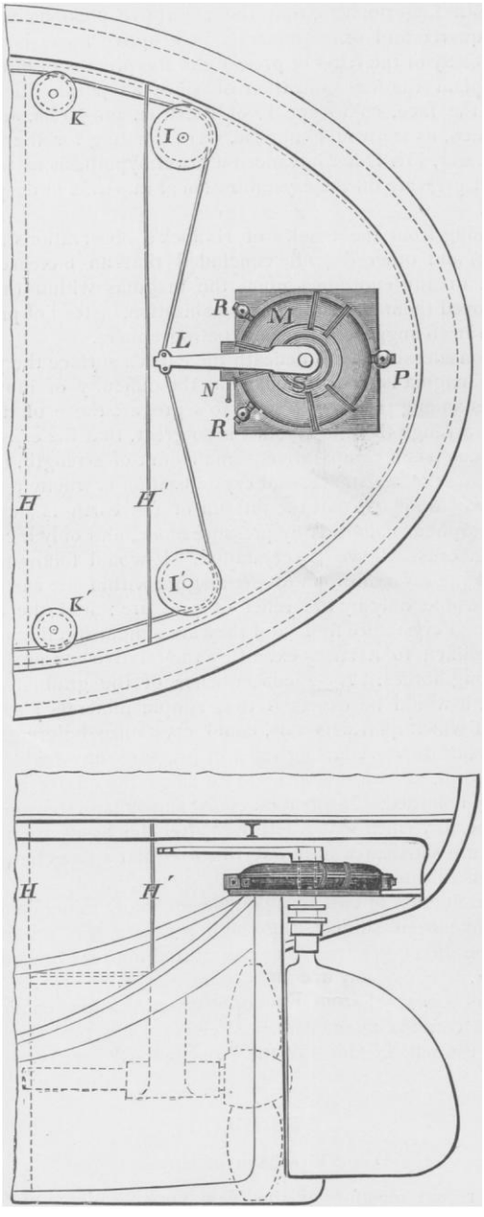
Hill Observatory, the United States Signal Office, Harvard College Observatory, the Institute of Technology, the Boston Water Works, and the Draper Manufacturing Company of New York. Owing to the generous response to the circular requesting the loan of articles, particularly by the United States Signal Service, the exhibition was a success, and was so well attended by visitors that it was continued three days longer than was originally intended. Now that the feasibility of such an exhibition has been demonstrated, it is to be hoped that others will follow, as there can be no doubt of their effect in stimulating the study of meteorology.

THE HORNIG DIRECT-POWER STEERING SYSTEM.

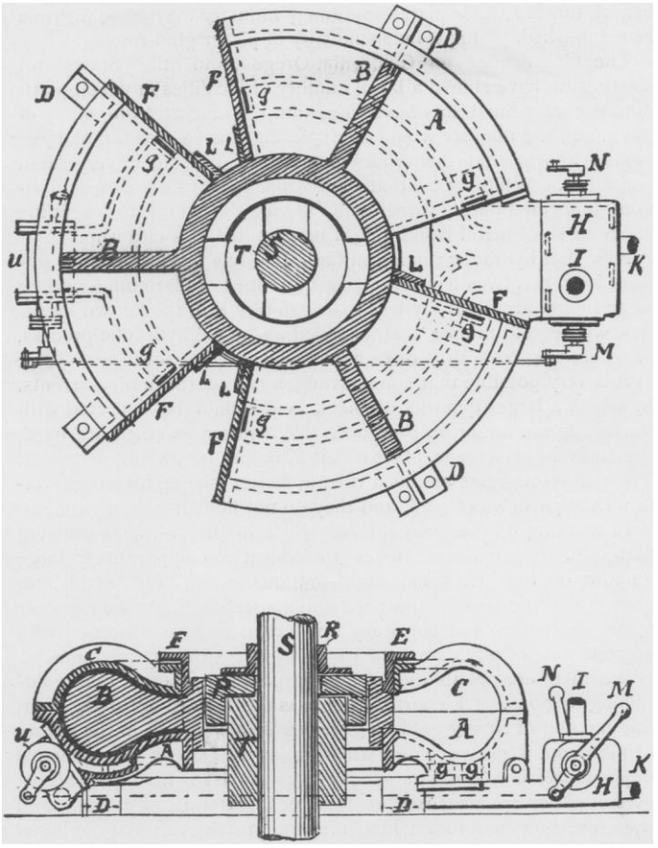
THE steering system herewith illustrated is the invention of Julius L. Hornig of Jersey City, N.J. It may be operated by steam, hydraulic, or pneumatic pressure, the last being preferable. The motor is attached directly to the rudder-head, as shown in the



FIGS. 1. AND 2.

illustrations, though a special form of the motor is made which may be placed in any convenient part of the vessel, connecting with the rudder by chains, ropes, or rods.

The motor is shown at *M* in Figs. 1 and 2, the usual tiller, *L*, not being removed, so that the vessel may be steered by hand if necessary. In fact, either hand or power steering may be done, or both at once, as neither system interferes with the other. *I* and *K* are guide-pulleys for the usual tiller-ropes. *R*, *R* are relief-cocks, and *P* is a regulator-cock for the brake.



FIGS. 3 AND 4.

The motor has three pistons, working in an annular chamber, as shown in Figs. 3 and 4. *A* and *C* are the bottom and top cases of the chamber; *B*, the pistons; *D*, the legs by which the motor is secured to the deck; *g*, the ports; *H*, the valve-chest; *I*, the inlet-pipe; and *K*, the outlet-pipe. *M* is a lever for working the regulator-valve *U*, and *N* is the main valve-lever. *S* is the rudder-head; *T*, the motor hub; and *F*, the end covers or abutments.

The reason for preferring pneumatic pressure to operate the motor is that liquids have practically no elasticity, and may freeze, while steam will condense. Air, on the other hand, is subject to no change; and its elasticity makes it an excellent cushion to receive the shocks of wave-blows, thus relieving the mechanism from sudden strain. In 1886 two boards of naval experts, acting under government instructions, made trials of pneumatic steering-gear, and reported its superiority over other methods.

The pressure-valve, which is operated by the lever, as shown in the cut, regulates the action of the pistons by supplying pressure to one side while relieving that on the other, or *vice versa;* while the pistons and rudder will remain stationary when the valve is kept closed. The motor may be controlled from any part of the vessel by any of the usual mechanical methods or by electrical transmission.

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