4 Sheets—Sheet 1.

# H. EXALL.

## Endless-Chain Propeller.

No. 206,551. Patented July 30, 1878.

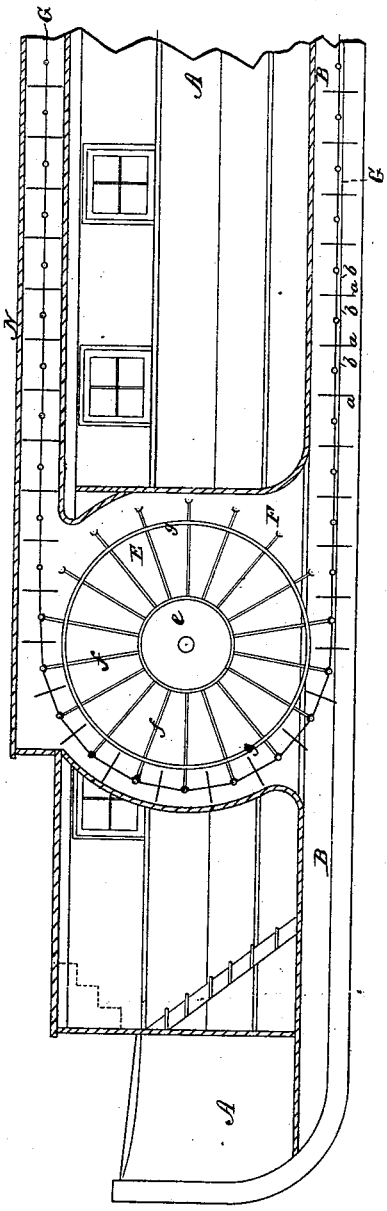

Fig. 1.

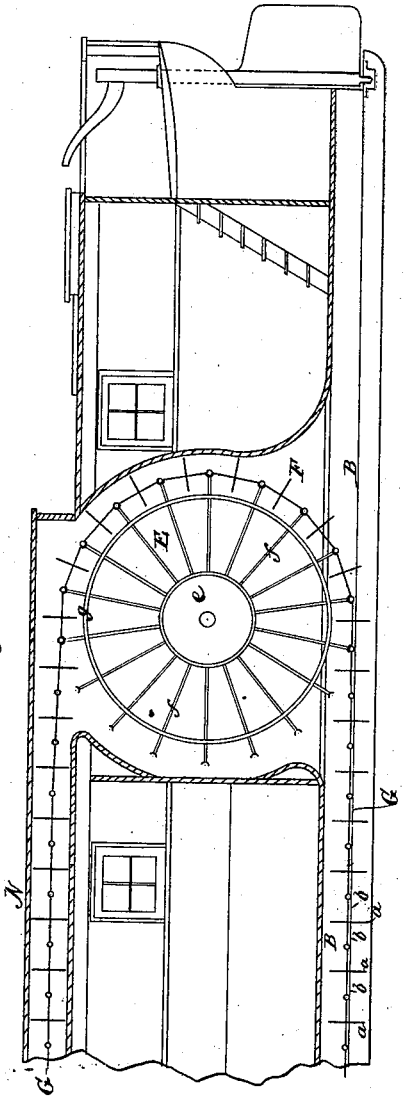

Fig. 2.

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Fig. 3.

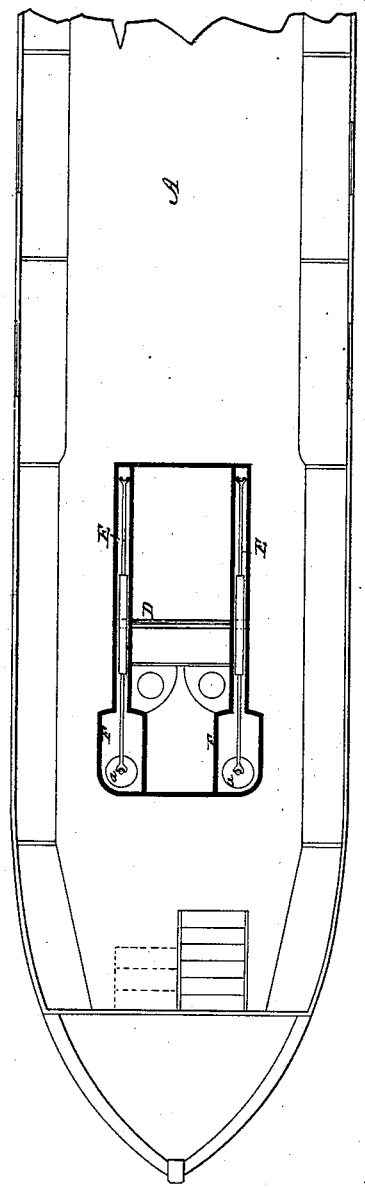
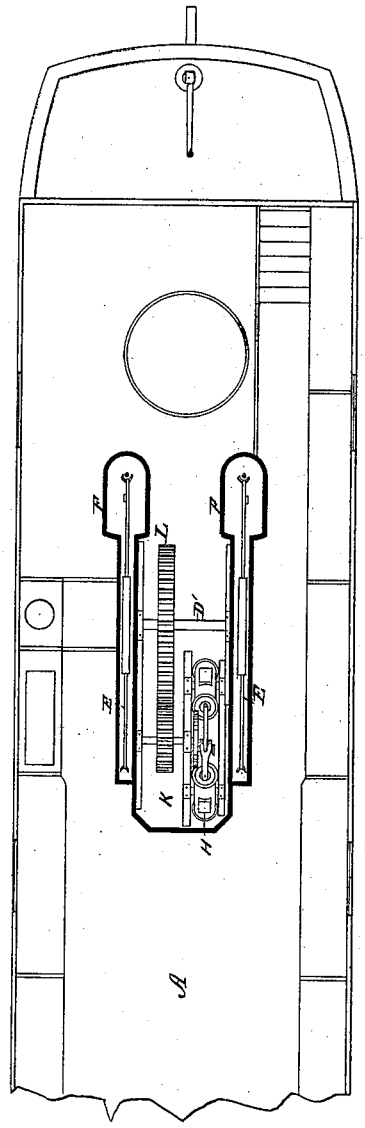



Fig. 4.

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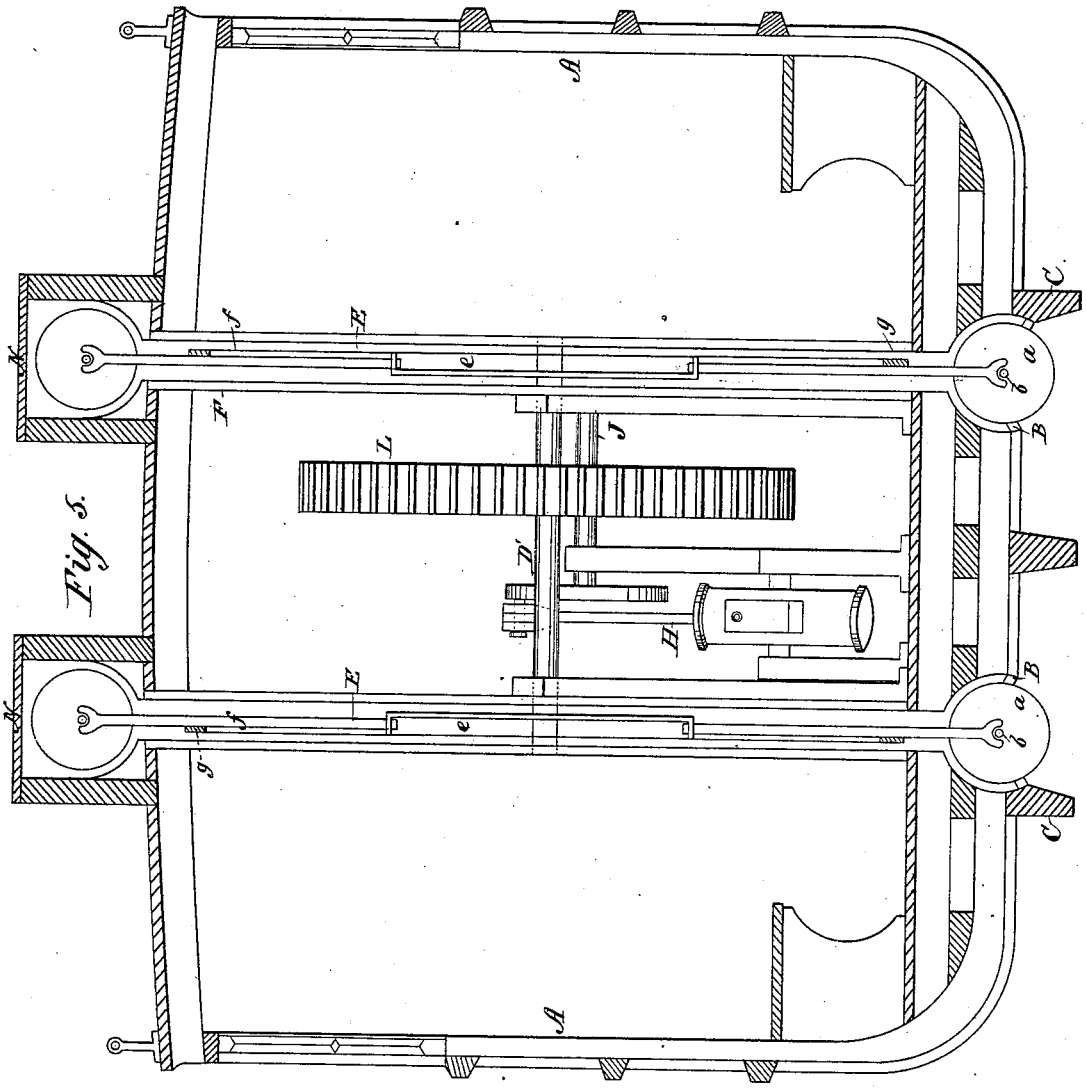


Fig. 5.

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4 Sheets—Sheet 4.

# H. EXALL.

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Fig. 6.

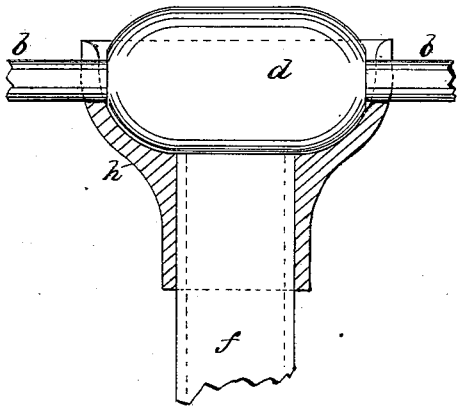



Fig. 7.

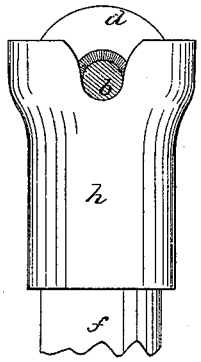



Fig. 8.

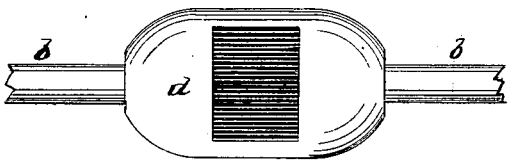



Fig. 10

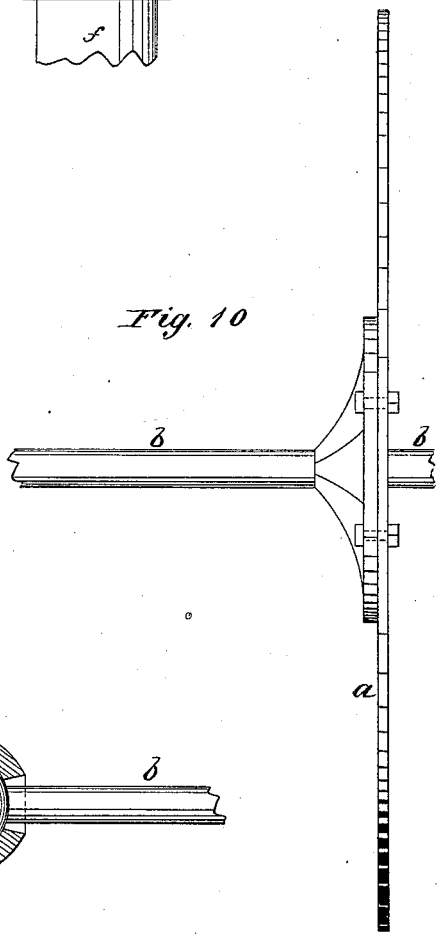
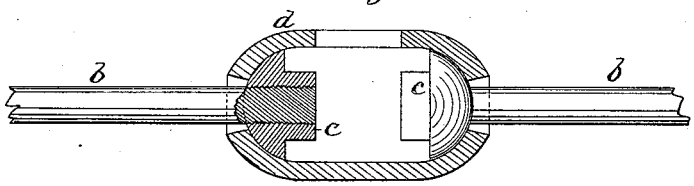



Fig. 9.

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# UNITED STATES PATENT OFFICE.

HENRY EXALL, OF RICHMOND, VIRGINIA.

## IMPROVEMENT IN ENDLESS-CHAIN PROPELLERS.

Specification forming part of Letters Patent No. **206,551**, dated July 30, 1878; application filed June 13, 1878.

*To all whom it may concern:*

Be it known that I, HENRY EXALL, of Richmond, in the county of Henrico and State of Virginia, have invented a new and Improved Endless-Chain Propeller; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, forming part of this specification, in which—

Figure 1 is a vertical longitudinal section of the forward, and Fig. 2 the same view of the aft, part of a boat to which my invention is shown applied. Fig. 3 is a plan view of the forward, and Fig. 4 the same view of the aft, part of the boat, the deck being removed; Fig. 5, a vertical transverse section on an enlarged scale. Figs. 6, 7, 8, 9 are enlarged detail views of the propeller-chain coupling, showing also the relation of the grabs of the wheels. Fig. 10 is an enlarged detail view of one of the paddles.

My invention relates to an improved endless-chain propeller constructed with a view to avoiding the objections incident to the use of the screw-propeller, and yet free from the complex and impracticable plans of the endless-chain propeller as heretofore attempted.

The defects of the screw-propeller for speed are due to the great disproportion of its resisting-surface to the resisting-surface of the vessel which it is designed to move, and with this form of propeller only a limited degree of speed can be obtained, for, after a certain rapidity of revolution has been obtained, any further increase has no corresponding effect in increasing the speed of the boat, but only produces foaming of the water. Its location at the stern also produces racing or sudden speeding of the propeller when the stern of the vessel is lifted out of the water by heavy swells, which frequently involves the breakage of the shaft and other derangement, to say nothing of the loss of effect upon the boat.

In adopting the endless-chain form of propeller I have taken advantage of conditions which obviate the objection just mentioned, and which secure an anchorage in the water, whereby the boat is more positively propelled, in contradistinction to producing currents in the water, and thus securing only a partial effect of the motive-power expended.

My invention consists, chiefly, in the form of the endless-chain, of which I employ two, one on each side of the boat, and the general arrangement of the chains and wheels with respect to the boat, designed to secure economy of space, a large operating-surface for the paddles, and compactness and strength of structure.

The invention also consists, among other details, in utilizing the draft of air produced by the return of the chain-paddles in the chain-box for the purpose of ventilating the boat and supplying the same with fresh air, as hereinafter more fully described.

In the drawing, A represents the hull of the boat, which may be constructed after any suitable model, the form here shown being that of a canal-boat, to which my invention may be applied to advantage. Longitudinally with the boat, and upon each side of the keel, are formed independent channels or ways B, Figs. 1, 2, 5, to receive the chain-paddles, which channels open laterally into the water, and are further deepened by protective keels C C, Fig. 5, which extend below the bottom of the chain-paddles and protect them against breakage from obstructions. Near the forward and aft portions of the boat, in suitable and substantial bearings, are arranged the transverse shafts D D′ of the two chain-wheels E E. About these wheels are formed wells F F, or narrow compartments to receive the wheels, which wells open through the bottom of the boat into the water, and are widened at the periphery of the wheels, where the chain touches them, to accommodate the passage of the paddles of the endless chain. G are said endless chains, which pass around both the wheels, and, descending through the wells, enter and move in the channels B beneath the boat and between the keels, to form, by their great superficial area, a decided anchorage in the water, against which the strain of the motive power is directed to give a more positive movement to the boat.

In constructing the chain-propeller I employ stiff sheet-metal disks *a*, which disks are rigidly attached to the middle portions of loosely-jointed rods *b*. In connecting these rods into a flexible continuous chain each rod terminates at its extremities with detachable screw-nuts *c*, Fig. 9, which are rounded upon one side and secured in a hollow circular-

shaped shell, *d*, to form a sort of double ball-and-socket joint. In connecting these rods with the shell the rods are inserted endwise through holes in the ends of the shells, the nuts inserted laterally through a middle hole in the shell, and then screwed upon the ends of the rods. This makes a detachable coupling, and at the same time a very strong and secure one. In addition to the function of connecting the rods, these shells *d* form projections on the chain, which are seized by the grabs or seats *h* of the chain-wheel, as shown in Figs. 6 and 7, thus permitting the latter to secure a firm hold upon the chain midway between the disks. The wheels E, Figs. 1, 2, 5, are constructed with hubs *e*, tubular spokes *f*, and bracing circular rims *g*, the said spokes having at their extremities forks, seats, cups, or grabs *h*, Figs. 6 and 7, which are adapted to receive the shells *d* of the chain.

In imparting motion to the wheels, and through them to the chains, any form of engine with suitable connections may be employed. As shown, a double oscillating engine, H, Figs. 4 and 5, is made to operate through the crank-plate I upon the shaft J, which latter carries a pinion, K, engaging with a large spur-wheel, L, fixed upon the rear one of the shafts D D, which connect the two sets of wheels.

N N, Figs. 1, 2, and 5, are the chain-boxes, which extend from the forward to the aft wheels, and inclose the portion of the chains and attached paddles extending from the tops of the front and rear wheels. These boxes project above the upper deck and serve as seats; and as the rear movement of the paddle-disks in these boxes produces a decided current of air, their closed character permit them to be used for ventilating the various portions of the boat and supplying fresh and pure air to the different parts of the same. As the paddles enter these boxes at the rear and pass to the front, air is carried in with them, and a forwardly-moving current produced. All that is necessary then to utilize the same is to keep the front-wheel compartment closed and carry the draft by means of pipes to the point desired, the air being always fresh, pure, and cool from its contact with the wetted surfaces.

The distinctive advantages of my invention are as follows: First, the manner of connecting the rod-sections to form a chain not only secures great strength and durability, but the coupling-shell affords a purchase for the grabs or forks of the wheel; secondly, the location of the rigid disk blades or paddles midway upon the rod-section and centrally upon the same simplifies the form of chain-propeller and reduces liability to derangement; thirdly, the small transverse dimension of the wheels and chain-propellers enables me to economize space and to utilize the vacant space even between the two wheels on the same shaft, which has heretofore been lost.

Having thus described my invention, what I claim as new is—

1. The endless-chain propeller consisting of jointed rod-sections having disk blades or paddles rigidly secured at their centers to the rod-sections and between the joints of the same, substantially as described.

2. The endless chain consisting of rod-sections having terminal nuts, knobs, or heads, combined with an inclosing-shell adapted to couple the rod-sections and form a hold for the grabs of the wheel, as set forth.

3. The combination, with the chain-propeller G, consisting of jointed rod-sections, coupling-wheels, and rigid disks, of the drive-wheel having radial grabs, seats, or sockets adapted to receive said coupling-shells and rotate the chain, as described.

4. The drive-wheel consisting of a central hub, with radial tubular spokes braced by a ring, in combination with grabs or sockets arranged detachably upon the ends of said spokes, as and for the purpose described.

5. The combination, with the drive-wheels and the endless-chain propeller, as described, of the hull having wells or compartments for the wheels made of greater dimensions in cross-section at the portion of the peripheries of the wheels in contact with the chain, as shown and described.

6. In a boat propelled by an endless-chain propeller, the method of ventilating the same by means of a current of air produced in a closed return-chain box, provided with suitable ventilating-pipes, substantially as set forth.

HENRY EXALL.

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CHAS. A. PETTIT.