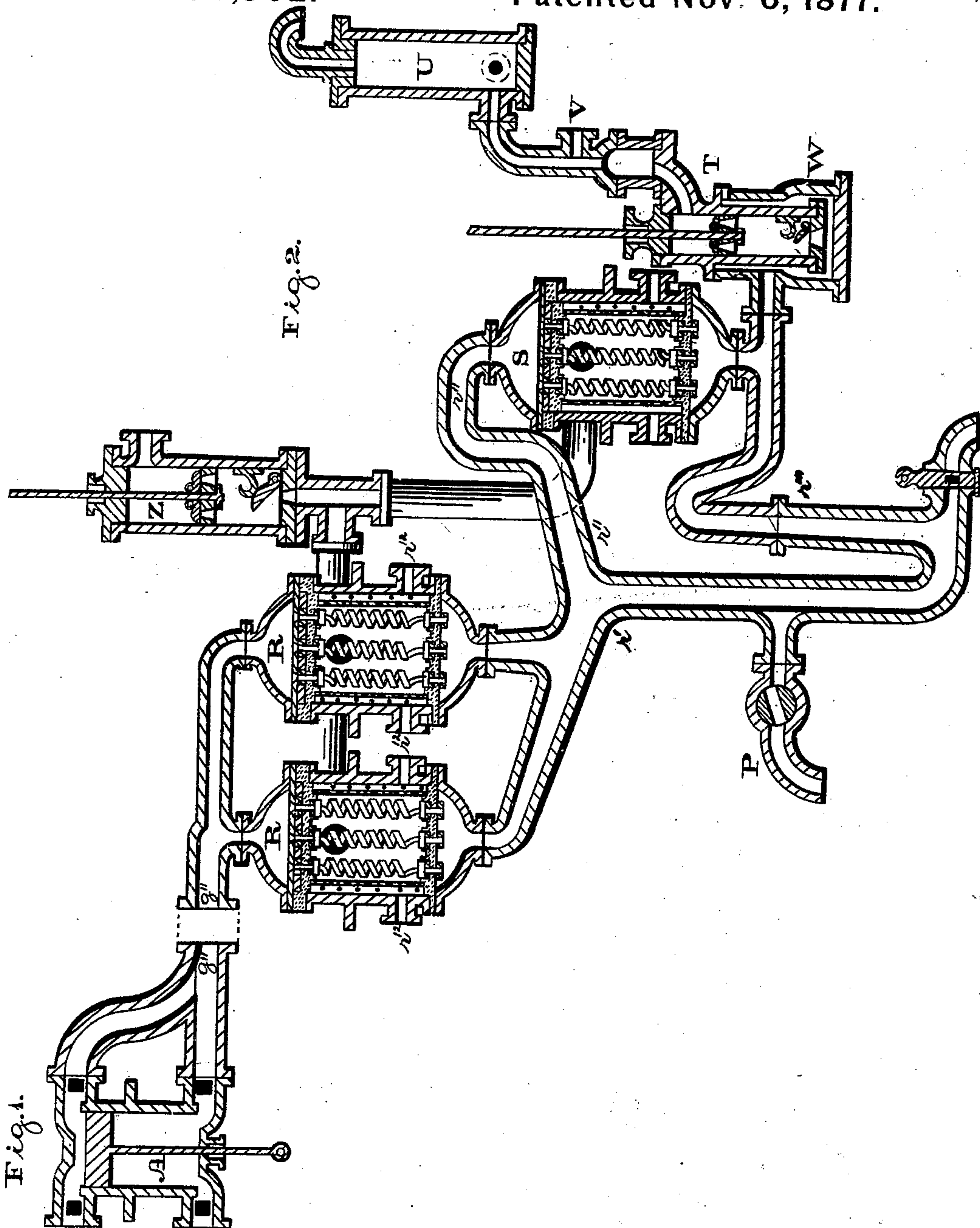


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Compound Condensing Apparatus for Steam-Engines.

No. 196,902.

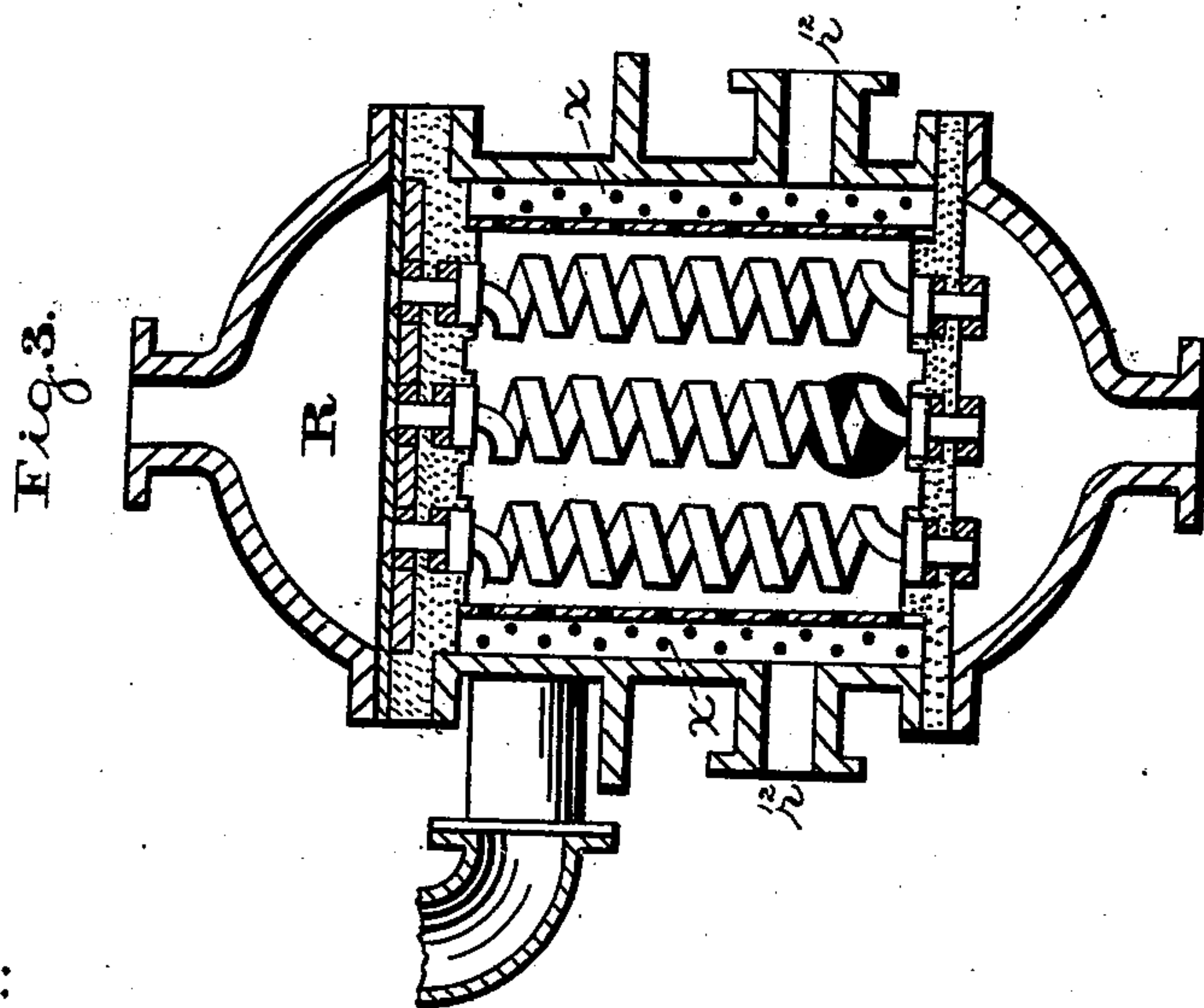
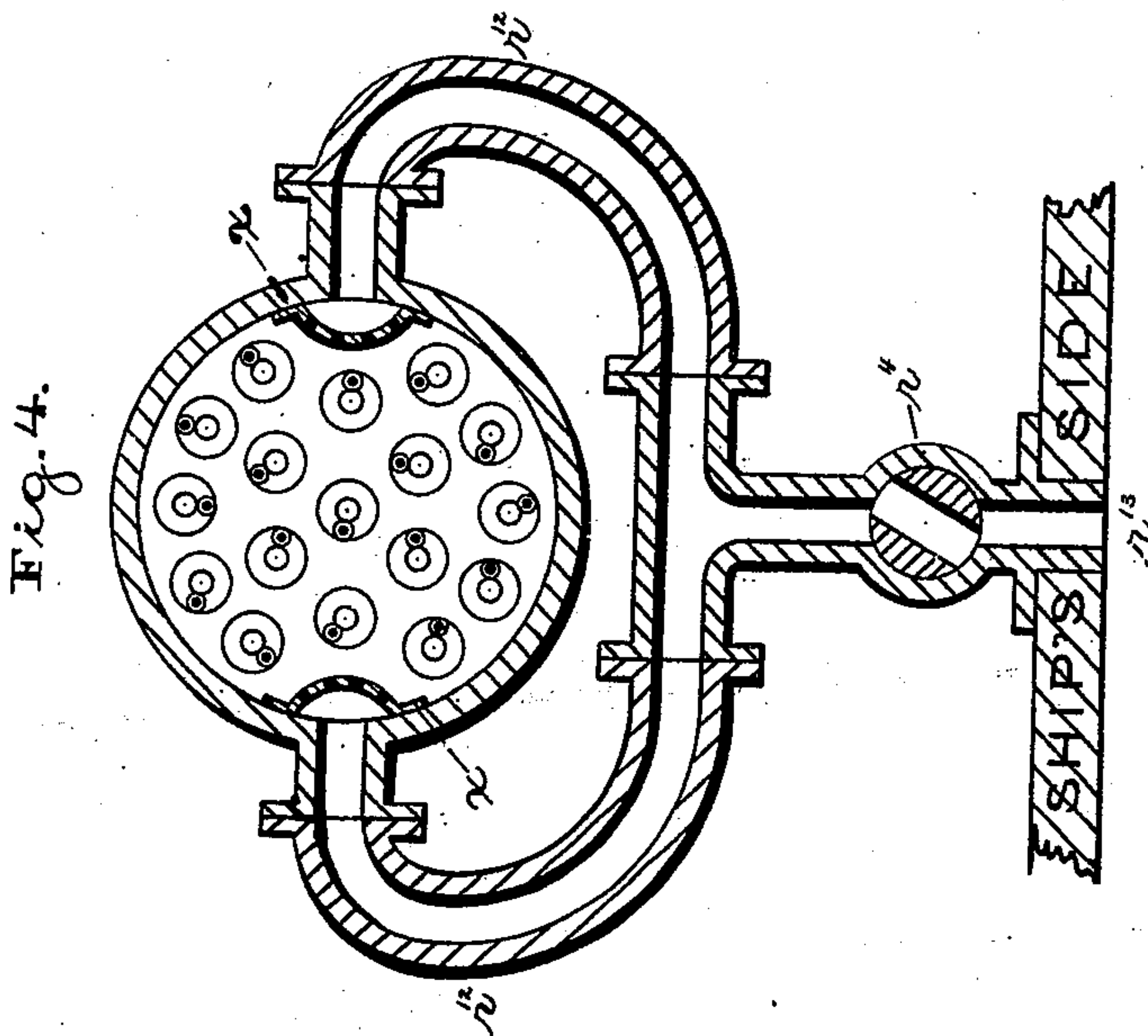
Patented Nov. 6, 1877.



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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN COMPOUND CONDENSING APPARATUS FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **196,902**, dated November 6, 1877; application filed July 2, 1877.

*To all whom it may concern:*

Be it known that I, JOHN HOUP, of Springtown, in the county of Bucks and State of Pennsylvania, have invented a new and useful Improvement in Compound Condensing Apparatus for Steam-Engines, which improvement is fully set forth in the following specification and accompanying drawings, in which—

Figure 1 is a central section of a steam-cylinder and connected pipes. Fig. 2 is a vertical section of the apparatus embodying my invention. Fig. 3 is an enlarged view of a portion of Fig. 2. Fig. 4 is a horizontal section thereof.

Similar letters of reference indicate corresponding parts in the several figures.

My invention relates to improvements in compound condensing apparatus for steam-engines; and it consists of the steam-cylinder in combination with a plurality of primary surface-condensing cases, by means of which the exhaust-steam from the steam-cylinder is cooled to a temperature a little below that of boiling water, (under a partial vacuum,) and the hot water of condensation drops down and passes off through pipes into the hot-well below, and is drawn off from thence by an air-pump, and forced into another hot-well for supplying the steam-boilers with hot fresh water.

Combined therewith is an attachment to a force-pump, so located that a large portion of the hot water of condensation from the primary surface-condensing cases may be drawn off and forced directly into the hot-well or into the steam-boilers without allowing it to pass through or to interfere with the air-pump, the object whereof is to supply the steam-boilers with hot fresh water at a higher temperature than could be afforded by the ordinary surface-condenser, and to economize fuel.

The hot vapor from the primary surface-condensing cases is drawn off by the action of the air-pump into the secondary surface-condenser, and it is there condensed to save the remnant of fresh water for supplying the steam-boilers, and to produce the desired vacuum in front of the steam-piston.

Referring to the drawings, A represents the steam-cylinder, exhaust-pipes of which com-

municate with primary surface-condensing cases R R, with which are connected pipes  $r'$   $r''$ , communicating with the hot-well W.

S represents the secondary surface-condenser, or "save-all," whose upper portion communicates with the pipe  $r'$  by means of a branch pipe,  $r''$ , and its lower portion with the pipe  $r'''$ , whereby it will be seen that the primary condensers are intermediate of the steam-cylinder and secondary condenser.

T represents the air-pump; U, the well; V, the hot-water-supply pipe for boilers, and Z the circulating-pump.

In the condenser-cases there are openings  $r^{12}$   $r^{12}$ , for the entrance of cold circulating sea-water into the said cases, and within the latter there are curved perforated deflectors X X, secured opposite to the inlet-opening running from the bottom to top of the cases, and adapted for a general distribution of the sea-water among the spirally-coiled surface-condensing tubes, to which, however, I do not confine myself, as small short and straight tubes may answer as well, if not better, for condensing the exhaust-steam, and for discharging the hot water and vapor more promptly from the primary surface-condensers, thus facilitating the escape of the exhaust-steam from the steam-cylinder.

In order to secure the said condensing-tubes to the brass tube-plates, the latter have angular openings, into which are fitted brass castings, forming the straight ends of the condensing-tubes, and having screw-nuts on the ends of said castings outside of the tube-plate, and a shoulder or jam-ring fitted into a shallow stuffing-box inside of the tube-plate, which is filled with a thick gum-elastic washer or other suitable packing, whereby, by drawing up the nuts on the outside of the tube-plate, the jam-ring will be closed onto the packing inside of the tube-plate, and make a perfect water-tight joint. Attached to the pipe  $r'$ , intermediate of said pipe and the pipe  $r'''$ , there is a connection, P, for a force-pump, (not illustrated in the drawings,) the object of which will be hereinafter stated.

In Fig. 4,  $r^{13}$  represents a pipe passed through the side of the ship and opening outward, and it communicates with the inlets or pipes  $r^{12}$   $r^{12}$ , whereby cold sea-water may be admitted into



the condensing-cases for purposes of condensation of the exhaust-steam, the supply being regulated by a cock,  $r^4$ , suitably applied.

It will be seen that as the exhaust-steam enters the primary surface-condensing cases R R, it will be cooled to a temperature below that of boiling water, (under a partial vacuum,) and the hot water of condensation drops and passes off through the pipes  $r' r'''$  into the hot-well W, and it is drawn from thence by the air-pump T and forced into the hot-well U, for supplying the steam-boilers with hot fresh water.

When it is required to supply the steam-boilers with hot fresh water at a higher temperature than could be afforded by the ordinary surface-condenser, and thus also economize fuel, the cock of the attachment P is turned, and the force-pump connected thereto is operated, whereby a large portion of the hot water of condensation from the primary surface-condensing cases R R may be drawn off and forced directly into the hot-well U, or into the steam-boilers, without allowing it to pass through or interfere with the air-pump T.

The hot vapor from the primary surface-condensing cases R R will be drawn from the pipe  $r'$  by the action of the air-pump, through the pipe  $r''$ , into the secondary surface-condenser or save-all S, and there condensed to save the remnant of fresh water for supplying the steam-boilers, and to produce the desired vacuum in front of the steam-piston.

By retaining a high temperature in the primary surface-condensers R R, intermediate of the steam-cylinder A and the secondary surface-condenser S, I check the cooling effects of the said secondary condenser from striking back into the steam-cylinder A, and prevent, in a great measure, the condensation of the high-pressure steam as it enters at each fresh charge into the steam-cylinder. This economizes the power of the high-pressure steam acting on the steam-piston when the engine is regularly at work.

When the low-pressure steam-engine is required to work at a light pressure of steam, (as is frequently the case,) there will then be less cooling-surface required by the surface-condenser than when the engine is properly at work with a regular pressure of steam acting on the steam-piston.

I therefore construct the primary surface-condenser of my compound condensing apparatus for marine steam-engines with a plurality of comparatively small surface-condensing cases connected with the exhaust-steam tube of the steam-engine. These may be from four to six or more in number, (instead of only two, as represented at R R, Fig. 2, of the accompanying drawings,) according to the magnitude of the works. Any one or more of said small cases may then be throttled off, by any suitable arrangement of throttle-valves or stop-cocks, so as to regulate the quantity of cold circulating sea-water in the remainder of the cases required to reduce the temperature of the exhaust-steam within them to a point a little below boiling water. The fresh water of condensation will thus be returned to the steam-boilers at a higher temperature than can be afforded by the ordinary surface-condensers, and at the expenditure of less fuel.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The primary surface-condensers R R and secondary surface-condenser S, in combination with the pipes  $r' r'''$  and connection P, substantially as and for the purpose set forth.

2. The primary surface-condensers R R and secondary surface-condenser S, in combination with the pipes  $r'$ ,  $r''$ , and  $r'''$ , and with the connection P, intermediate of the pipes  $r'$  and  $r'''$ , substantially as and for the purpose set forth.

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Witnesses:

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