No. 615,914.

Patented Dec. 13, 1898.

L. SCHUTTE.

CONDENSER.

(Application filed May 7, 1897.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 3.

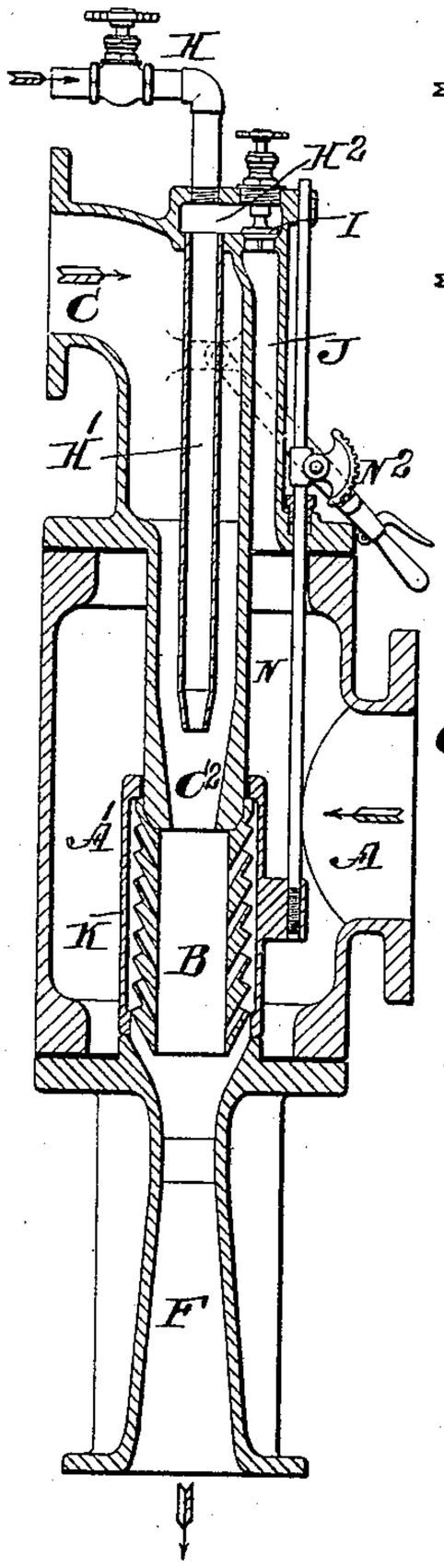

Fig. 1.

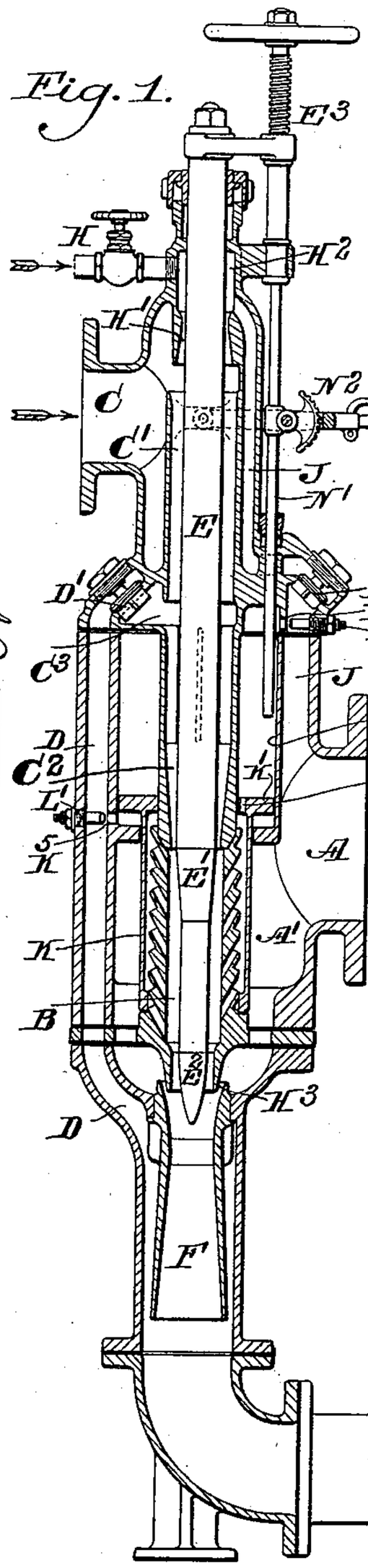

Fig. 2.

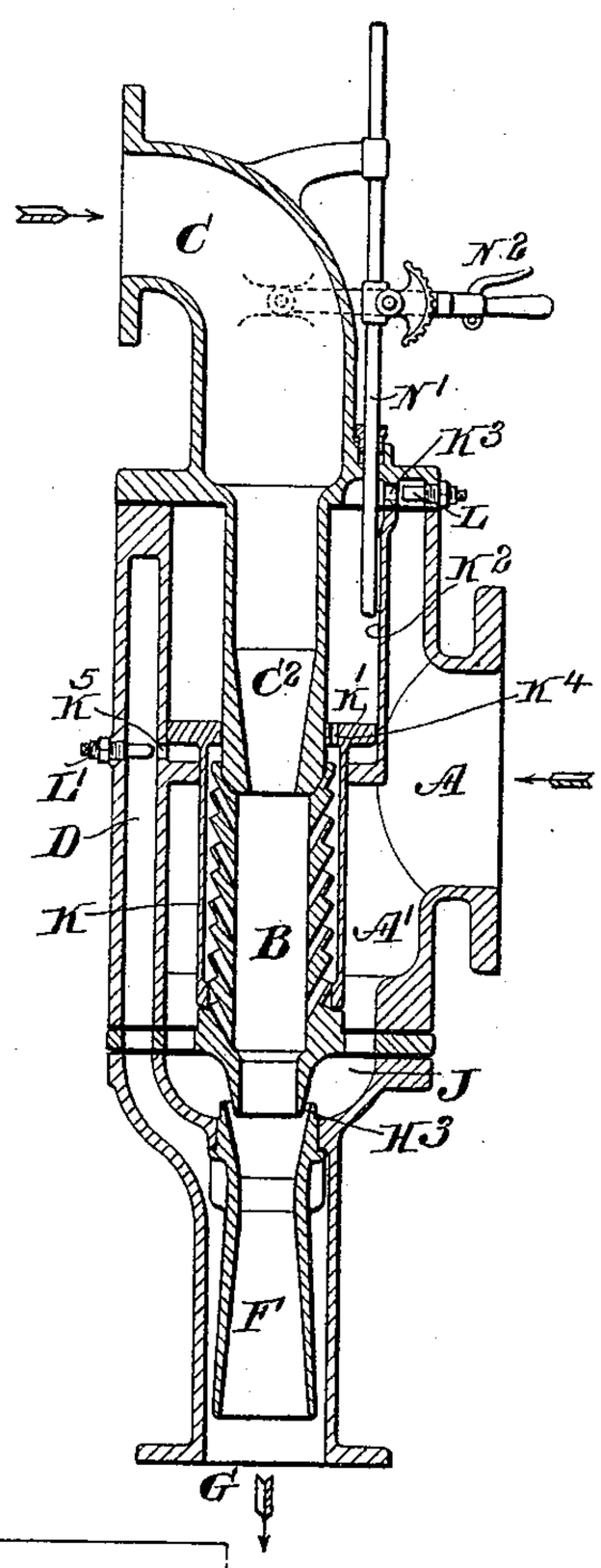

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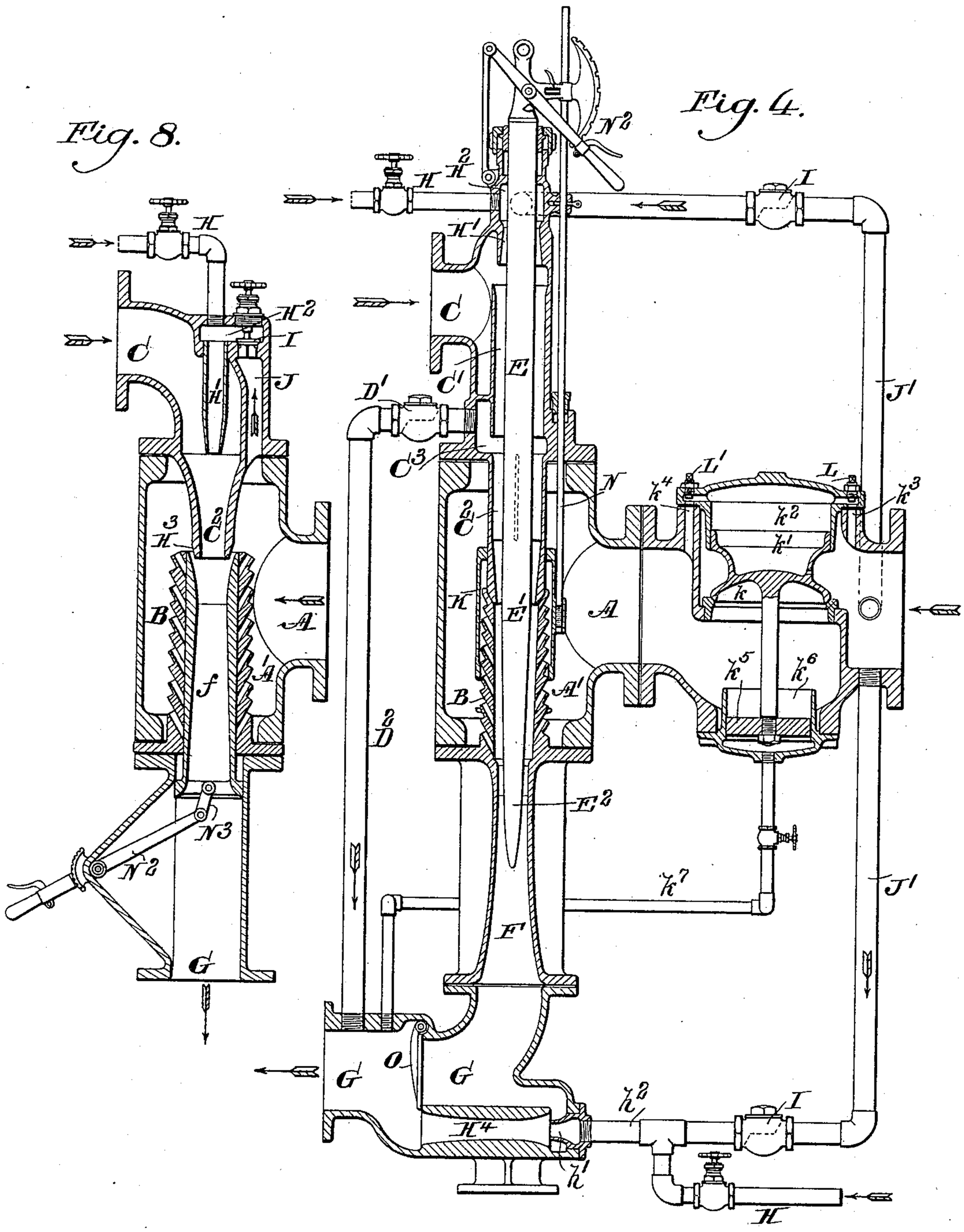
Fig. 8.

Fig. 4.



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(Application filed May 7, 1897.)

(No Model.)

4 Sheets—Sheet 3.

Fig. 2.

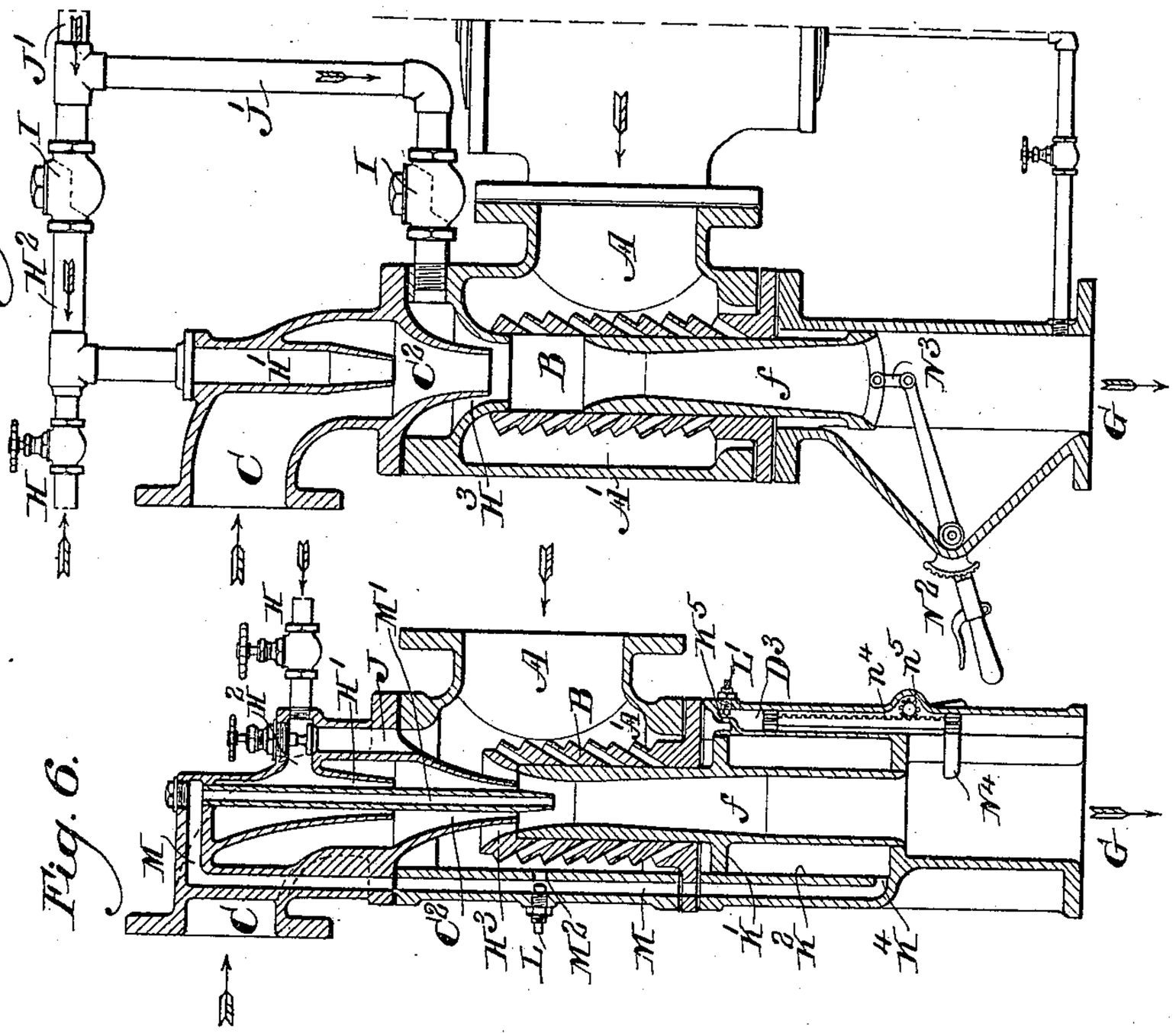
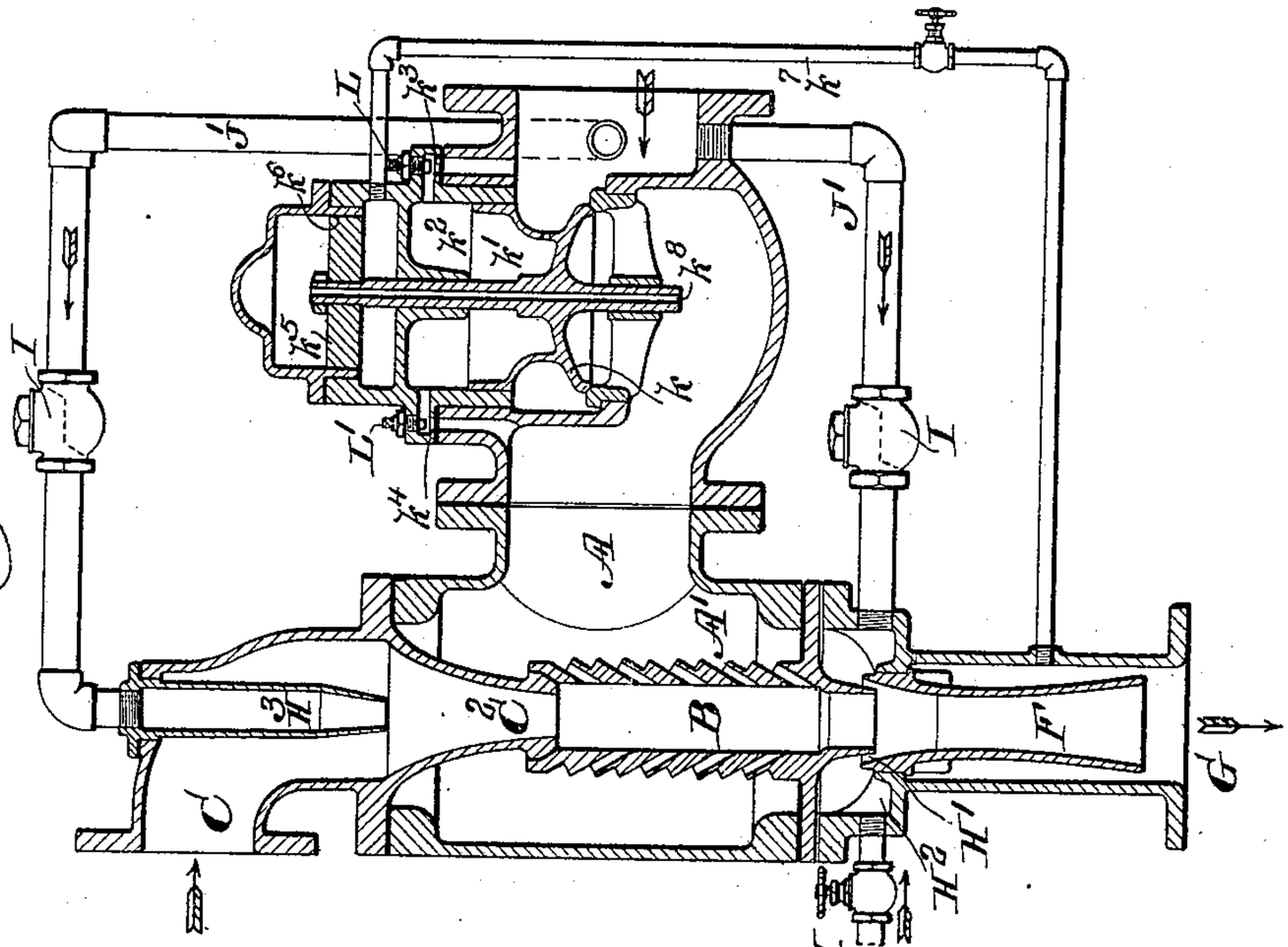


Fig. 6.

Fig. 5.



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CONDENSER.

(Application filed May 7, 1897.)

(No Model.) 4 Sheets—Sheet 4.

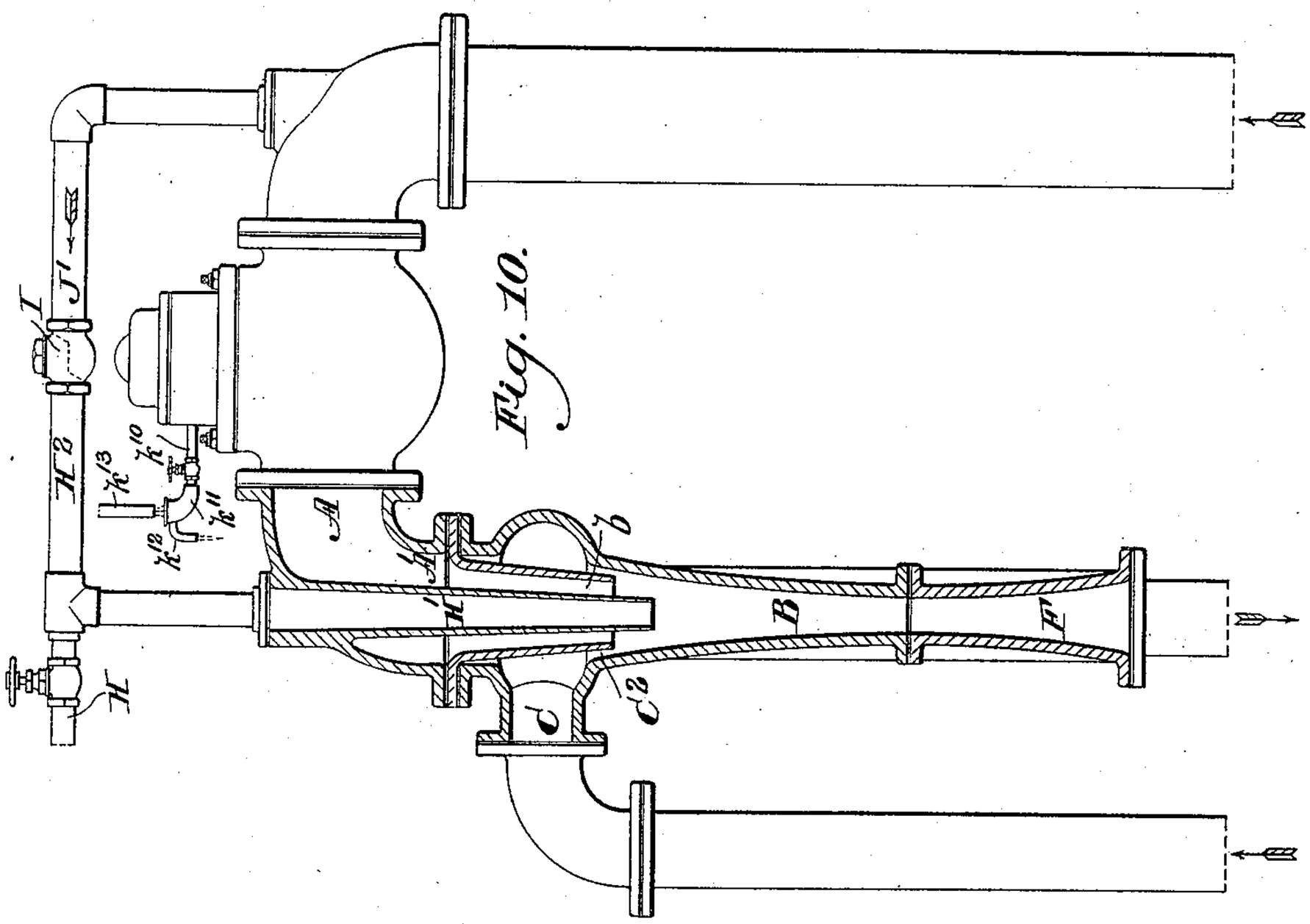

Fig. 10.

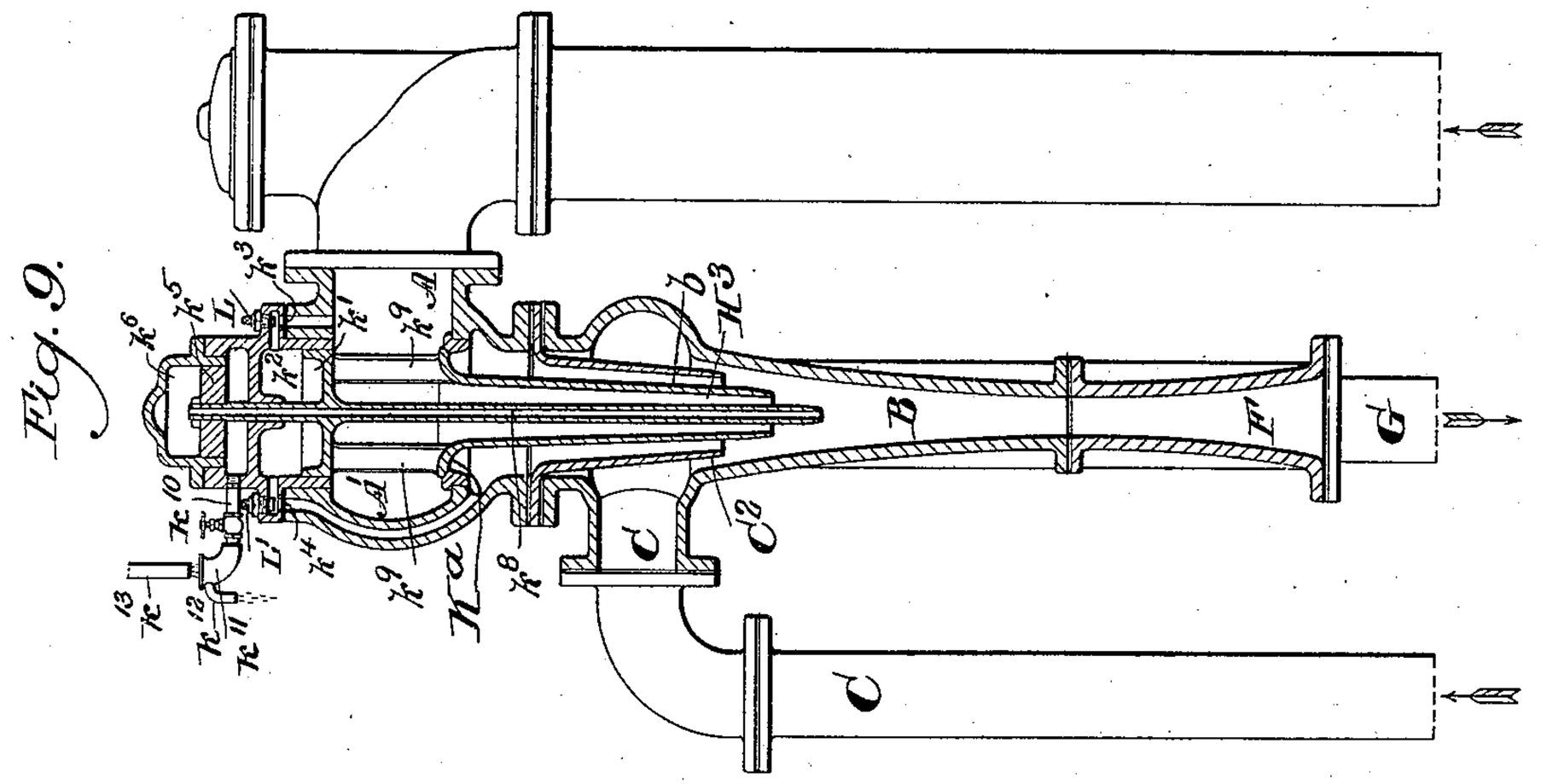

Fig. 9.

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UNITED STATES PATENT OFFICE.

LOUIS SCHUTTE, OF PHILADELPHIA, PENNSYLVANIA.

CONDENSER.

SPECIFICATION forming part of Letters Patent No. 615,914, dated December 13, 1898.

Application filed May 7, 1897. Serial No. 635,495. (No model.)

To all whom it may concern:

Be it known that I, LOUIS SCHUTTE, a citizen of the United States of America, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Improvement in Condensers, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to that class of condensers commonly known as "water-jet" or "induction" condensers and which are characterized by the presence of a combining-tube through which the water-jet passes and into which the exhaust-steam enters to be brought in contact with the water and ejected through a discharge-tube. In condensers of this kind water can be raised to a considerable height by the action of the vacuum created by the jet, and when once established an energetic jet action is maintained, the steam being drawn in by the sucking and condensing action of the water. Such condensers, however, particularly when the water-supply has to be drawn up to the condenser, are more or less troublesome to start in operation, and the object of my invention is to provide means whereby the water-jet can be established more rapidly and conveniently, as well as with less power, than has heretofore been the case. Particularly, however, I aim to provide means for starting the condenser in action by the action of the exhaust-steam and preferably to make the starting of the condenser automatic, so that if stopped for any cause, accidentally or otherwise, it will at once resume proper action.

The leading feature of my invention consists in providing a valve by which the free admission of steam to the combining-tube of the condenser can be partly, as well as wholly, cut off when it is desired to start the condenser, and in addition to this valve I provide means whereby a water-jet through the condenser can be established by the aid of the increased pressure of the exhaust-steam due to the closing of said valve and a vacuum or potential vacuum also established before the valve is opened and the exhaust-steam admitted to the condensing-tube.

My starting device consists of a supplemental combining-tube with, of course, communication with the water-supply pipe and a steam-jet leading from the exhaust-conduit opening to the condenser and from that portion of said conduit which is on the admission side of the cut-off valve, the action of the cut-off valve being obviously to cause back pressure in the exhaust-steam conduit which will raise the pressure of the steam to any desired point at which the supplemental steam-jet and combining-tube will operate effectively.

Another important feature of my invention is the provision of means whereby the cut-off valve is opened by the creation of a vacuum of determined amount in the condenser, and in its more perfected and entirely automatic form I control the cut-off valve entirely by the vacuum, causing it to close if for any reason atmospheric pressure or pressure higher than a determined amount exhausts in the condenser and to open when the condenser-vacuum attains a determined amount.

Reference is now had to the drawings, which illustrate my invention in various modifications and as applied to various well-known types of induction-condensers, in which—

Figure 1 is a sectional elevation of a condenser provided with my improvements in their most perfect and complete form. Fig. 2 illustrates the application of my improvements to a somewhat different form of condenser and with appropriate modifications. Fig. 3 is a similar view showing the cut-off valve arranged to be actuated by hand only and also illustrating certain modifications in the construction of the supplemental jet apparatus. Fig. 4 is a view of a condenser of generally similar type to that illustrated in Fig. 1, showing the presence of two cut-off valves, one hand-operated and the other automatic, the automatic valve being situated in the exhaust-steam pipe of the condenser. Figs. 5, 6, 7, 8, 9, and 10 are additional views showing various modifications in the form of the condenser and in the details of the application of my invention thereto.

A indicates the opening for exhaust-steam leading into the condensing-body, (indicated at A′.)

B indicates the combining-tube, and, as illustrated in Figs. 1 to 8, inclusive, is of a type in which it extends through the body A′

of the condenser, the water-jet entering its top and numerous oblique openings being formed through its sides for the entrance of steam. In Figs. 9 and 10 the combining-tube B is of a different but equally familiar type, being situated below the condenser-body A′, the exhaust-steam entering its top through one or more nozzles and meeting there the water-jet, which also enters at its top, the water and steam combining as they pass through the tube.

C in all cases indicates the water-supply pipe, and C^2 the nozzle through which the water enters the combining-tube, the nozzle being of different forms, as indicated in different views. In Figs. 1 and 4 there is an independent combining-tube C′ situated above the nozzle C^2 and forming during the normal operation of the condenser a mere conduit for water on its way to the nozzle C^2. Its use is as a combining-tube in the starting of the injector and will be fully explained.

D, Fig. 1, is a passage formed in the walls of the condenser-body leading from the waste-water pipe G or from below the discharge-tube of the condenser and serving, in the construction shown in this view, a double purpose—viz., to maintain atmospheric pressure in the lower part of the cylinder K^2 and also to serve as a waste-water pipe opening from the chamber C^3, as will be hereinafter described. The similar passage marked D in the construction shown in Fig. 2 serves only to maintain atmospheric pressure in the lower part of the cylinder K^2. The pipe marked D^2 in Fig. 4 serves the same purpose as the passage D in the figures before mentioned in so far as serving as a waste-water conduit in the chamber C^3 is concerned. In Fig. 6, again, the passage marked D^3 serves the same purpose as the passage D in Fig. 2, leading from below the discharge-tube to the cylinder K^2, and although it is here shown as entering the top of the cylinder instead of the bottom it will be seen that it performs precisely the same function, the cylinder being reversed.

D′, Figs. 1 and 4, indicates an upwardly-opening valve which permits the flow of water from the chamber C^3 into the passage D or pipe D^2, but closes on the establishment of a vacuum in the chamber C^3.

E, Figs. 1 and 4, indicates a spindle such as is commonly used in condensers of the type illustrated in these figures, the portions E′ and E^3 regulating the size of the orifices at the top and bottom of the condensing-tube and the spindle being longitudinally adjustable, as shown in Fig. 1, by the action of the hand-screw E^3, while in Fig. 4 it and the sleeve-valve are adjusted by the lever N^2.

F is the discharge-tube, into which the combining-tube leads. In the constructions illustrated in Figs. 6, 7, and 8 this combining-tube (here marked *f*) is made also to serve the purpose of a cut-off valve, as will be seen, and will be hereinafter described.

G is the waste-water pipe leading from the discharge-tube.

H, Figs. 1, 3, 4, 5, 6, 7, 8, and 10, indicates a high-pressure steam or water supply pipe leading to the condenser and by which live steam can be admitted to start the apparatus, In each case the live steam passes to a jet, (indicated at H′,) which may be of the various forms shown or of any convenient form, in all cases being so placed and arranged as to act as a suction-jet to induce a vacuum in the supply-pipe C, and thereby draw water into the condenser. In Fig. 4 I have shown two live-steam pipes, one entering at the top of the condenser and the other supplying a jet (here indicated at *h*′) leading into a combining-tube H^4, situated in a portion of the waste-water pipe G, a valve O being provided, so that when the vacuum is established in the portion of the waste-water pipe nearest the condenser the valve will close and a vacuum thus be established through the discharge-tube of the condenser to the water-supply pipe. Of course as soon as a flow of water is established the live steam is shut off, and the water will then flow freely through the discharge-pipe, the valve O offering no obstacle to it. I have indicated at H^2 a steam-chamber through which the live steam passes on its way to the nozzle H′ and into which also opens a passage J, as indicated in Figs. 1, 3, 6, and 8, or a pipe J′, as indicated in Figs. 4, 5, 7, and 10, the passage or pipe in each case leading through the exhaust-steam pipe on the admission side of the cut-off valve, to be hereinafter described, and being provided with a valve I, which opens to permit the passage of exhaust-steam through the passage or pipe to the chamber H^2, but closes against passage of fluid in the opposite direction. The function of the passage or pipe, which are the full equivalents for each other, is to supply exhaust-steam to the starting-nozzle H′, and the said starting-nozzle may be exclusively supplied with the exhaust-steam, as is the case in the construction shown in Fig. 2, where the starting-nozzle is indicated at H^3, also in the upper part of Fig. 5, where the starting-nozzle is also indicated at H^3, and in Fig. 9, where I have also used the symbol H^3 to indicate the starting-nozzle. At K, Figs. 1, 2, 3, and 4, I have illustrated a cut-off valve made in the form of a sleeve surrounding the combining-tube B, and whereby the said combining-tube can be wholly or partly closed to the admission of exhaust-steam. At *k*, Figs. 4 and 5, I have indicated a cut-off valve serving the same purpose as the sleeve-valve K, but situated in the exhaust-steam conduit, or rather between it and the condenser-body. A valve similarly placed is indicated also in Fig. 10, although not shown in detail. At K^a, Fig. 9, I have illustrated still another modification in the construction of the cut-off valve adapted to serve the same purpose as the others, while at *f*, Figs. 6, 7,

and 8, I have shown methods of construction by which the discharge-tube of the condenser is made longitudinally movable on the inside of the combining-tube, so as to serve not only as a discharge-tube but also as a cut-off valve. The primary function of all the various modifications illustrated and above referred to is to serve as a cut-off valve whereby the free admission of the exhaust-steam to the combining-tube can be checked to any desired extent.

In the constructions shown in Figs. 3 and 4 the sleeve-valve K is actuated by a rod N and hand-lever N^2, by which, as is plainly indicated, the valve can be raised or lowered to any desired position. So, also, in Figs. 7 and 8 the discharge-tube *f*, acting as a cut-off valve, is actuated by hand-lever N^2, acting through a link N^3. In all the other constructions illustrated the action of the valve is automatic. Thus, referring first to Fig. 1, it will be observed that a piston K′ is secured to a sleeve-valve K and arranged to work in a cylinder K^2, said cylinder communicating at the top through a small orifice K^3 with the chamber A′ of the condenser, and the upper part of the cylinder also communicating through a small orifice K^4 (here shown as formed through the piston) with the combining-tube B. In this construction an opening K^5 leads from the lower part of the cylinder into the passage D, having for its function the admission of atmospheric pressure to the under side of the piston. L and L′ are threaded adjustable rods serving to regulate the effective opening through the ports or passages K^3 and K^5. In this construction an adjustable rod N′, operated by a hand-lever N^2, serves as a stop to regulate the height to which the piston K′ and the sleeve-valve K may rise, thus of course regulating the extent to which the combining-tube shall be in effective operation. It will be seen that by the above-described construction, the condenser not being in use, the piston K′ and valve K will move downward, closing the connection between the combining-tube and the body of the condenser. In this condition exhaust-steam under small pressure will enter the upper part of the cylinder K^2 and add its pressure upon the top of the piston to hold the valve closed, a certain amount escaping through the small orifice K^4. The exhaust-steam being unable to enter the combining-tube will issue in restricted quantity through the nozzle H^3 and also raising the valve I will pass through the channel J and chamber H^2 to the nozzle H′, creating a vacuum both in the discharge-tube F and in the combining-tube C′, the energy of the jets increasing as the pressure of the exhaust-steam rises in the exhaust-steam conduit until sufficient suction is inserted to draw in the water through the water-pipe C, and to prevent the water column being checked when established I provide the chamber C^3, with its valve D′, through which the water can escape freely through the passage D to the waste-water pipe G. It is of course obvious that in starting the condenser in this way the vacuum is created in the inside of the combining-tube and of the sleeve-valve K surrounding it, in consequence of which the steam contained in the cylinder K^2 is drawn out through the port K^4 more rapidly than it is supplied by steam entering through the port K^3, in consequence of which a vacuum is established in the cylinder and the piston K′ drawn up, raising the valve K and gradually opening the combining-tube to the admission of steam from the exhaust-pipe, said steam being at once condensed by the water passing through the combining-tube and the apparatus being thus automatically brought into full working condition, whereupon by reason of the vacuum established in the body A′ of the condenser the valve I closes and the jet through nozzle H′ ceases to operate. It will also be obvious that the valve D′ will automatically close by reason of the fall in pressure in the chamber C^3 as soon as the condenser is in operation.

In case it is desired to use live steam in starting the condenser the valve in the pipe H is opened, whereupon the steam will pass through the chamber H^2 to the nozzle H′, the valve I of course closing under the pressure of the live steam, but otherwise the apparatus working as above described, the live steam being of course cut off as soon as working conditions are established.

In the construction shown in Fig. 2 the conditions affecting the automatic operation of the sleeve-valve are substantially the same as in Fig. 1, the main difference being that in Fig. 2 reliance for starting the injector into operation is placed entirely in the nozzle H^3, formed between the end of the combining-tube and the discharge-tube F.

In the construction shown in Fig. 3 the closing and opening of the sleeve-valve K is in no sense automatic, but dependent entirely upon the manipulation of the hand-lever N^2. The starting of the apparatus, the valve K being closed, results from the passage of a steam-jet either through the live-steam pipe H and through chamber H^2 into nozzle H′ or the passage of an exhaust-steam jet through passage J, valve I, chamber H^2, and nozzle H′.

In the construction shown in Fig. 4 the sleeve-valve K is used simply as an adjusting-valve to regulate the effective exposure of the combining-tube to the body A′ of the condenser. As here shown, the sleeve is not of sufficient length to entirely close the passages leading from the body of the condenser to the combining-tube, and the lowermost passages might therefore serve the purpose of the nozzle H^3 in Figs. 1 and 2. In other respects the construction of the condenser proper is substantially the same as shown in Fig. 1, except that in place of a channel D a waste-water pipe D^2 is employed to lead from the chamber C^3 to the pipe G. In this construc-

tion also another starting-nozzle is provided at H^4, and the automatic starting of the condenser without reference to the position of the sleeve-valve K is provided for by means of the cut-off valve *k*, to which is connected a piston *k'*, working in a cylinder k^2, a restricted port k^3 leading from the admission side of the exhaust-steam conduit into the cylinder k^2 and another restricted port k^4 leading from the said cylinder into the delivery side of the exhaust-steam conduit and being hence in free communication with the inside of the combining-tube. It will be seen that the construction of the valve *k* and piston *k'* is such as to substantially balance the valve against pressure in the exhaust-steam pipe. Below the valve *k* and attached to said valve is a piston k^5, working in a cylinder k^6, the lower portion of which communicates through a pipe k^7 with the waste-water pipe G, the purpose of this connection being to insure the existence of atmospheric pressure on the under side of the piston k^5 and the dimension of the said piston being such as to be nearly of equal area to the lower exposed area of the valve *k*. The condenser being out of use and the valve *k* closed the admission of exhaust-steam to the exhaust-steam conduit will, by reason of the balanced construction of the valve, not tend to open it, while at the same time the exhaust-steam entering the cylinder k^2 and acting upon the valve *k'* will tend to hold the valve to its seat. The exhaust-steam, however, passes through the pipes J' J' to the nozzles H' and *h'*, establishing a vacuum, as heretofore explained, and drawing a column of water through the inlet C and through the combining-tube. The vacuum established of course extends from the body A' of the condenser and into that part of the exhaust-steam conduit lying on the delivery side of the valve *k*. Owing to this vacuum the steam in the cylinder k^2 is drawn out through port k^4 and the piston *k'* caused to move upward, raising the valve *k*, the balancing-piston k^5 preventing the vacuum from holding the valve *k* to its seat. The exhaust-steam then passes freely to the combining-tube and the condenser is in full operation.

Referring next to Fig. 5, the construction of the automatic valve is here substantially the same as in Fig. 4, except that the balancing-piston k^5 is situated above the valve *k*, as is also the cylinder k^6. The pressure existing on the delivery side of the valve *k* is admitted to the upper part of the cylinder k^6 through a port k^8, while from the under side of the piston extends the pipe k^7, leading to a point in the waste-water pipe or its connections at which atmospheric pressure prevails. It will thus be seen that the valve and its attachments are substantially identical in mode of action with those shown in Fig. 4. In this construction also the raising of the water column and starting of the condenser are effected partly through the action of exhaust-steam passing through the upper pipe J' to the nozzle H^3 and partly through the action of exhaust-steam passing through the lower pipe J' and the chamber H^2 to the nozzle H' at the lower end of the combining-tube. I have marked this particular nozzle with the symbol H', because it is shown in connection with the chamber H^2, into which leads a live-steam pipe H, as well as an exhaust-steam pipe J'.

Referring next to the construction shown in Fig. 6, in which the combined discharge-tube and cut-off valve indicated at *f* is provided with a piston K', working in the cylinder K^2, from the lower portion of which leads a small port K^4, connecting through a channel M with the body A' of the condenser through small port M^2 and also with the tube M', opening into the top of the combining-tube, as shown, the top of the cylinder K^2 connects by a small port K^5 and channel D^3, leading therefrom, with a part of the waste-water conduit in which atmospheric pressure prevails. N^4 is a finger attached to a rack n^4, which is raised and lowered by turning a pinion n^5, the finger serving, if desired, to raise the valve *f*, so as to close connection between the combining-tube and the body of the condenser except through the nozzle indicated at H^3 and here shown as at the top of the combining-tube. The finger N^4 principally serves, however, as a regulating-stop to determine how far the valve *f* shall be permitted to uncover the steam-ports leading to the combining-tube. In this construction when it is desired to start the condenser the exhaust-steam is turned on and, entering the body A', communicates its pressure through the port M^2, passage M, and port K^4 to the cylinder K^2 and the under side of the piston K', as a result of which the tubular valve *f* is thrust upward, closing all communication between the combining-tube and the body of the condenser, leaving it only free to pass through the nozzle H^3 at the top of the combining-tube and the nozzle H', leading into the jet C^2. The jets thus established raise the water and establish a water-jet through the tubular valve *f*, in which also an increasing vacuum is established, which communicates through the pipe M', passage M, and port K^4 with the nozzle of the cylinder K^2 and draws the piston K' downward, uncovering the steam-ports leading into the combining-tube and putting the condenser into operative condition, the tubular valve *f* serving, of course, as a discharge-tube in its lowermost position.

In the construction shown in Fig. 7 the tubular valve and discharge-tube *f* is operated solely by hand, while the starting-jets are established through the nozzles H' and H^3, both connecting with pipe J', which of course leads from the admission side of an automatic valve such as is indicated in Fig. 5, if such a valve is used.

In Fig. 8 the valve and discharge-tube *f* is

also worked solely by hand, the starting-jets here being established through a nozzle H^3 at the top of the combining-tube and a nozzle H'.

In Fig. 9 my invention is shown applied to a form of induction-condenser differing considerably in structure, though not in principle of action, from those shown in former figures. The cut-off valve (here indicated at K^a) cuts off the passage of exhaust-steam through the annular nozzle, which I have indicated at *b*, causing it to pass through the nozzle H^3, lying inside of the nozzle *b* and of proportions which enable it to act as a starting-nozzle, but not to freely discharge the entire volume of exhaust-steam. The valve is connected by standards k^9 with a piston *k'*, working in cylinder k^2, into which, as before, lead restricted ports k^3 and k^4, one from the admission and the other from the delivery side of the valve. The balancing-piston k^5, with its cylinder k^6, and the passage k^8, leading to the upper portion of the said cylinder, are substantially the same as are indicated in Fig. 5; but in place of connecting the under side of the piston with the waste-water pipe I here show a connection k^{10} leading directly to the atmosphere, an upwardly-extending connection k^{11} being provided, into which water is led to run from a pipe k^{13}, k^{12} being a waste-water spout. It will be clearly seen that the valve K^a will seat itself when the condenser is not in use and will remain seated after the exhaust-steam is admitted to the valve-casing until the vacuum established by the jet through nozzle H^3 creates a vacuum in the combining-tube B, which is communicated through nozzle *b* and restricted port k^4 to the cylinder k^2, and, acting upon the piston *k'*, lifts the valve k^2, permitting the exhaust-steam to pass freely into the nozzle *b* and establishing full action in the condenser.

The construction indicated in Fig. 10 is of the same general character as that in Fig. 9, except that I have here shown the same condenser as would be constructed where an automatic valve is provided outside of the condenser-body, as indicated, for instance, in Fig. 5.

It will be understood from what I have said and the various modifications illustrated in the drawings that my invention is not dependent on details of construction, but consists in the application of the cut-off valve and starting-jets to an induction-condenser in any convenient form, though preferably by such mode of construction as will make the starting of the condenser automatic in the manner fully described.

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

1. In an induction-condenser, a valve arranged to temporarily cut off the flow of the exhaust-steam to the combining-tube in combination with means for establishing a flow of water through said combining-tube while the flow of exhaust-steam thereto is checked and valve-opening mechanism as specified actuated by the vacuum in the condenser and whereby said valve is opened and the exhaust-steam freely admitted to the combining-tube when a determined vacuum is attained.

2. In an induction-condenser a valve arranged to temporarily cut off the flow of the exhaust-steam to the combining-tube in combination with means for establishing a flow of water through said combining-tube while the flow of exhaust-steam thereto is checked, a piston connected to the valve whereby it can be opened and closed, a cylinder wherein said piston works and restricted orifices leading into said cylinder from the exhaust-steam conduit and from the condenser substantially as specified and whereby the pressure of steam in the exhaust-conduit is transmitted to the cylinder and acts to move or hold the piston in position to close the valve until the rising vacuum in the condenser exhausts said steam from the cylinder and drawing up the piston raises the valve connected therewith.

3. In an induction-condenser having a main and supplemental combining-tube, a valve adapted to temporarily interrupt the flow of exhaust-steam to the main combining-tube, in combination with means, as specified, whereby a steam-jet can be established through the supplemental combining-tube and a flow of water therethrough thereby established and valve-opening mechanism as specified actuated by the vacuum in the condenser whereby the valve closing the main combining-tube is opened when a determined vacuum is attained.

4. In an induction-condenser having a main and supplemental combining-tube, a valve adapted to temporarily interrupt the flow of exhaust-steam to the main combining-tube and a passage not closed by said valve leading from the exhaust-steam conduit to the supplemental combining-tube whereby a steam-jet having the energy of the back pressure established by closing the main escape-passage for the steam, can be established through the condenser and a flow of water therethrough established.

5. In an induction-condenser having a main and supplemental combining-tube, a valve adapted to temporarily interrupt the flow of exhaust-steam to the main combining-tube, a passage not closed by said valve leading from the exhaust-steam conduit to the supplemental combining-tube whereby a steam-jet, having the energy of the back pressure established by closing the main escape-passage for the steam, can be established through the condenser and a flow of water therethrough established, a piston connected to the valve whereby it can be opened and closed, a cylinder wherein said piston works and restricted orifices leading into said cylinder from the exhaust-steam conduit and from the condenser substantially as specified and whereby the

pressure of steam in the exhaust-conduit is transmitted to the cylinder and acts to move or hold the piston in position to close the valve until the rising vacuum in the condenser exhausts said steam from the cylinder and drawing up the piston raises the valve connected therewith.

6. In an induction-condenser having a main and supplemental combining-tube, a valve adapted to temporarily interrupt the flow of exhaust-steam to the main combining-tube, and a passage independent of the body of the condenser not closed by said valve leading from the exhaust-steam conduit to the supplemental combining-tube whereby a steam-jet having the energy of the back pressure established by closing the main escape-passage for the steam, can be established through the condenser and a flow of water therethrough established, a non-return valve as I situated in said conduit, a piston connected to the valve whereby it can be opened and closed, a cylinder wherein said piston works and restricted orifices leading into said cylinder from the exhaust-steam conduit and from the condenser substantially as specified and whereby the pressure of steam in the exhaust-conduit is transmitted to the cylinder and acts to move or hold the piston in position to close the valve until the rising vacuum in the condenser exhausts said steam from the cylinder and drawing up the piston raises the valve connected therewith.

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