No. 654,633. Patented July 31, 1900.

A. H. HELANDER.

CONDENSER.

(Application filed Mar. 3, 1900.)

(No Model.) 2 Sheets—Sheet 1.

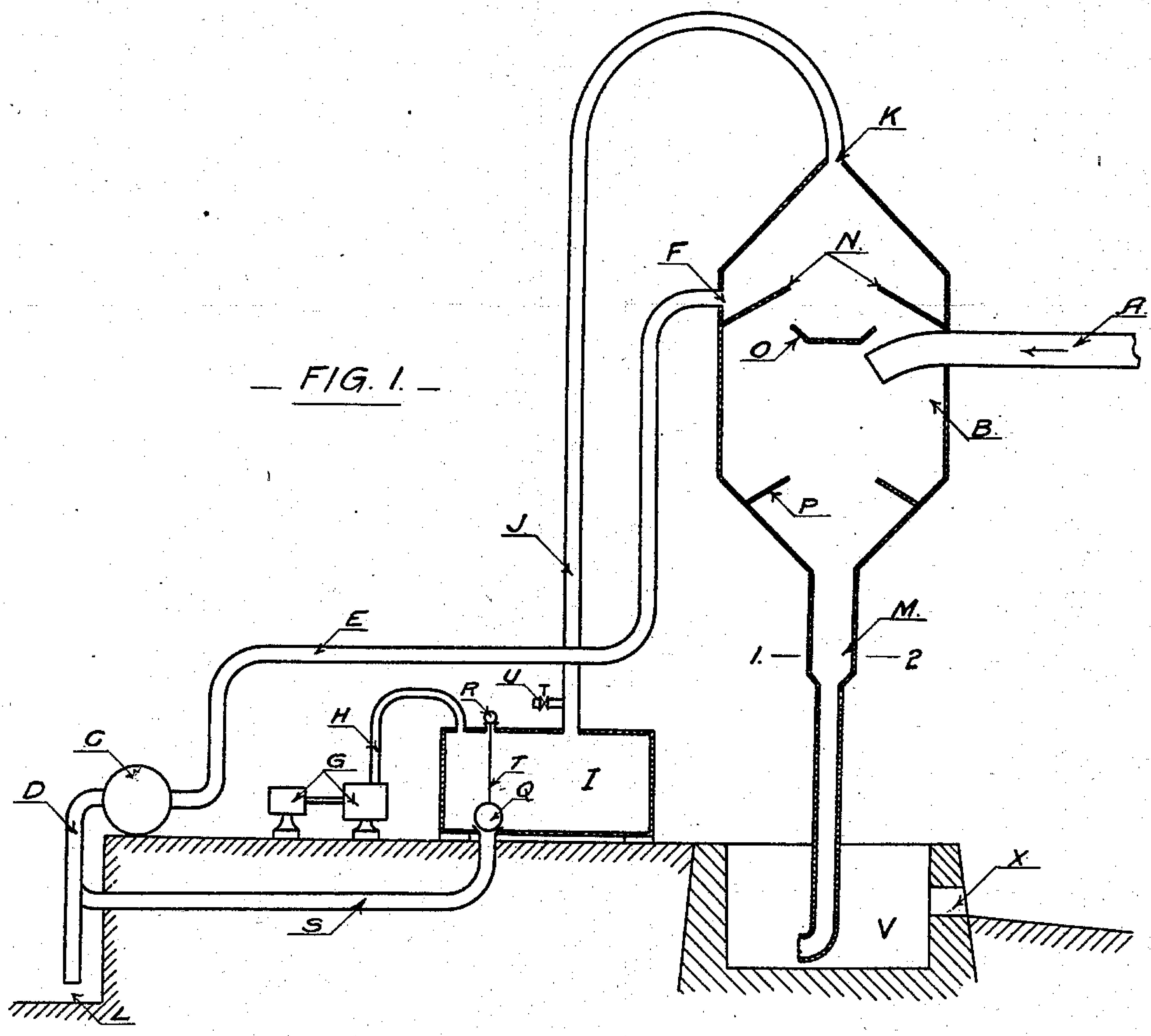

FIG. 1.

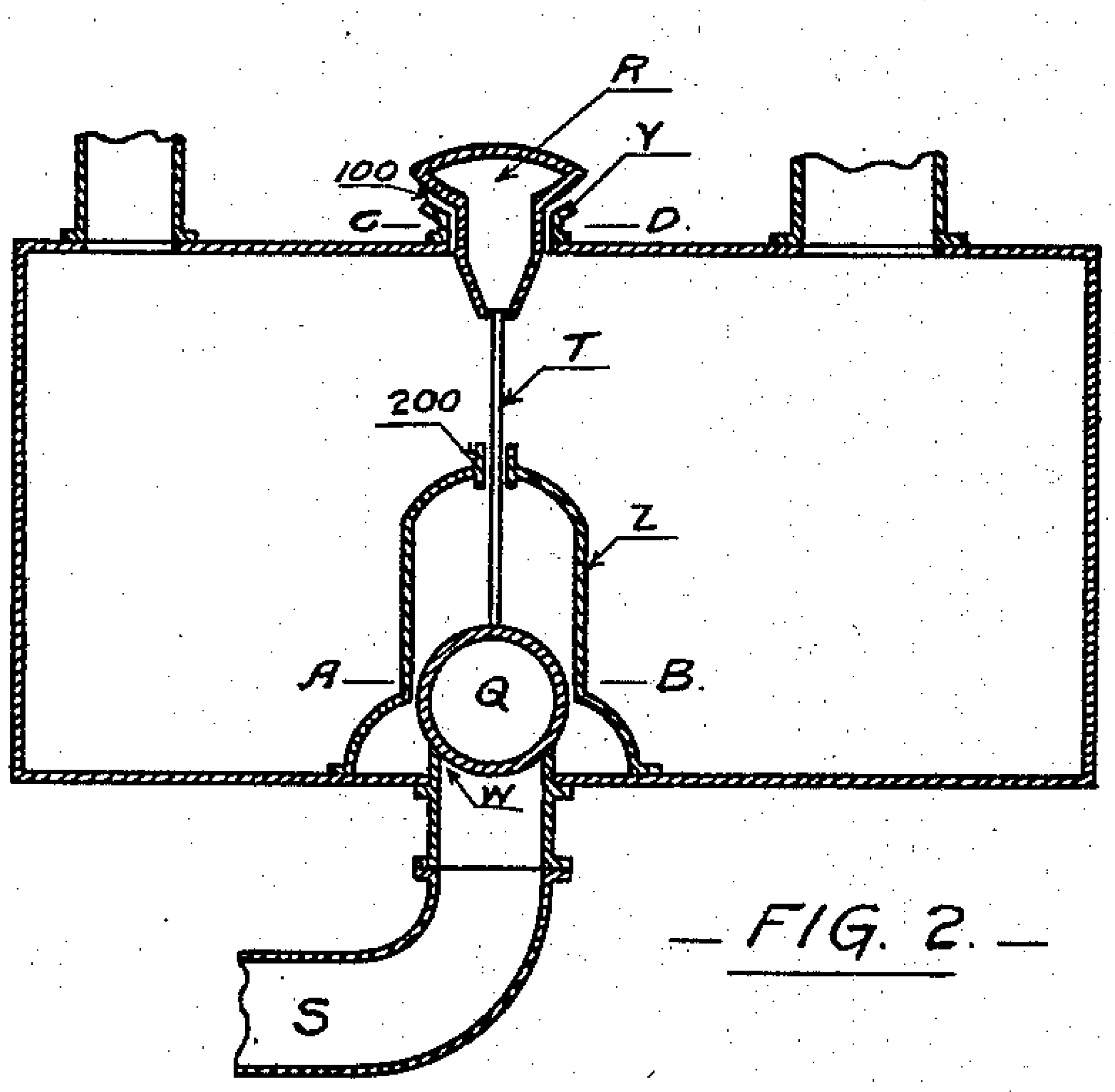

FIG. 2.

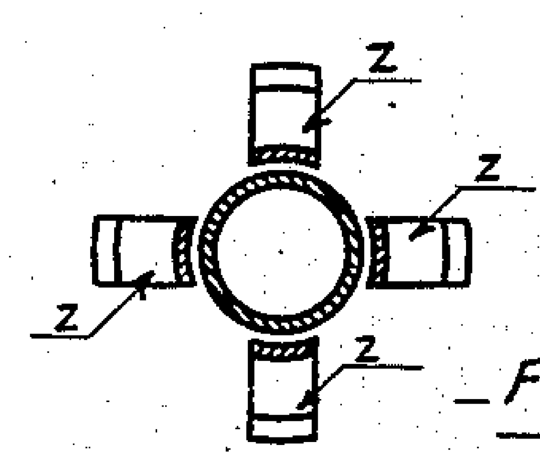

FIG. 3.

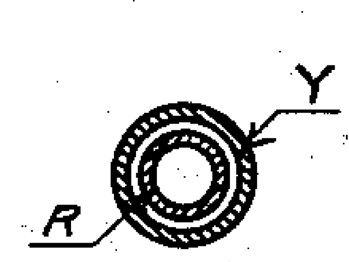

FIG. 4.

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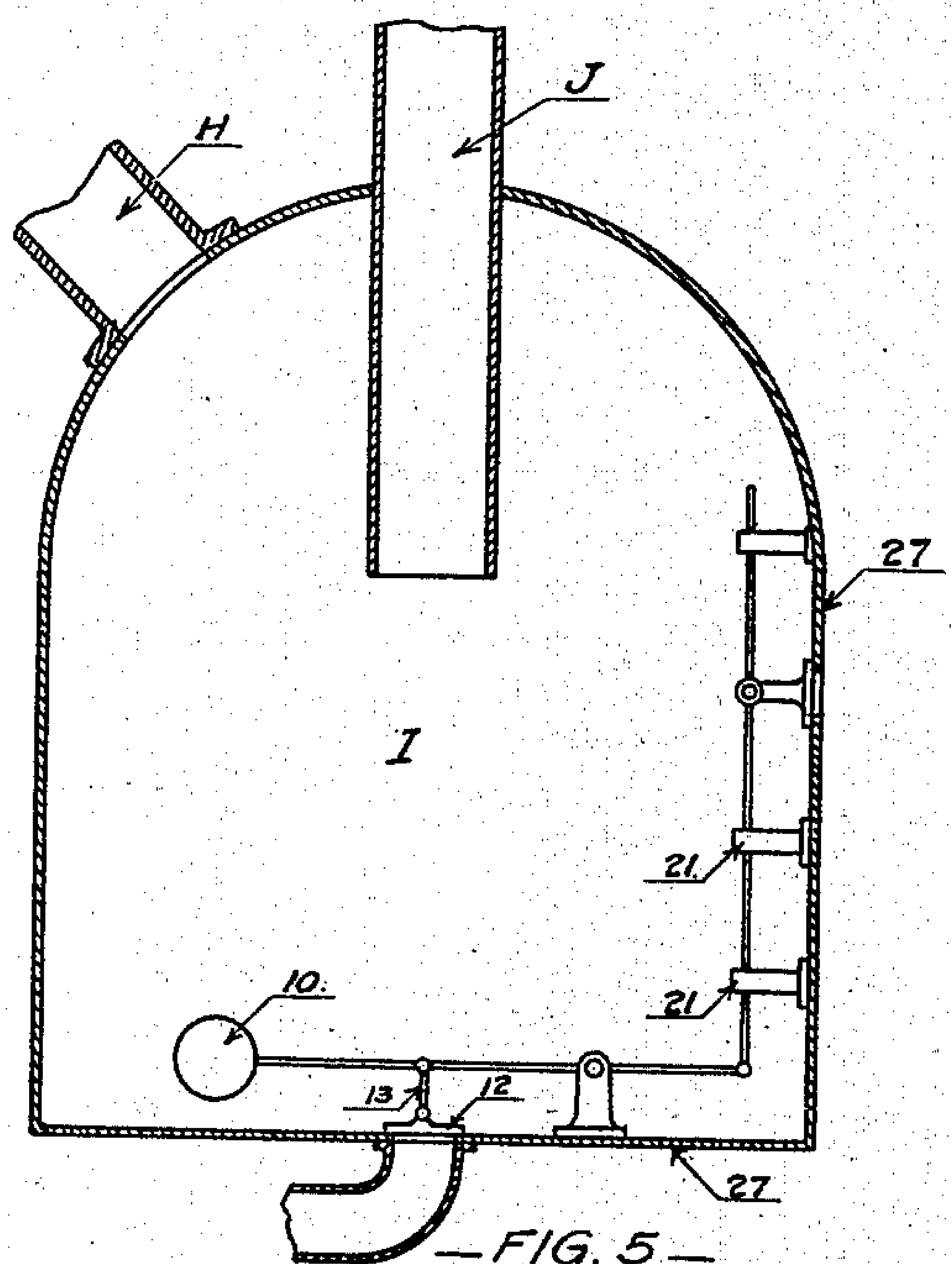

FIG. 5.

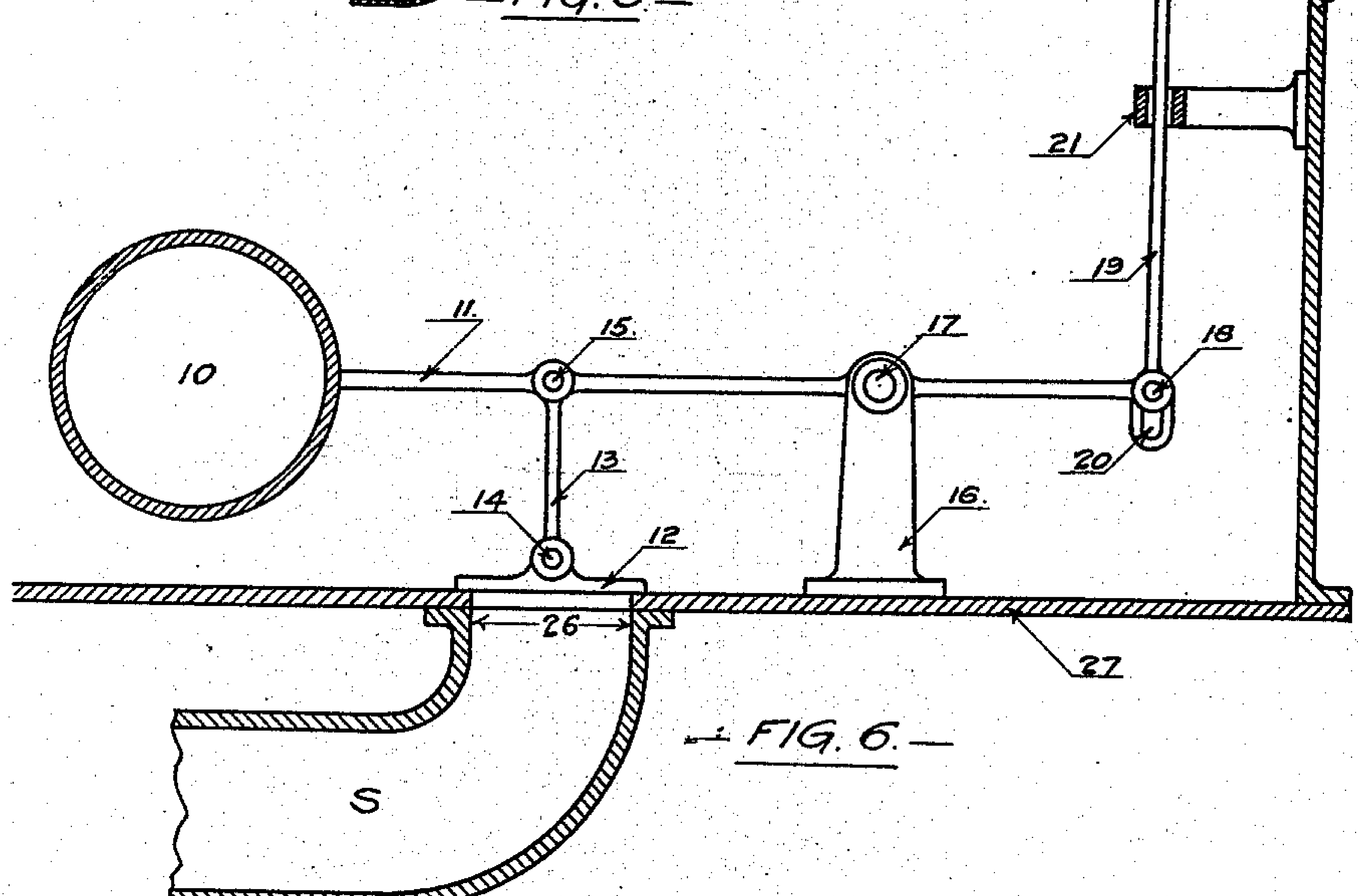

FIG. 6.

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UNITED STATES PATENT OFFICE.

AXEL H. HELANDER, OF PHILADELPHIA, PENNSYLVANIA.

CONDENSER.

SPECIFICATION forming part of Letters Patent No. 654,633, dated July 31, 1900.

Application filed March 3, 1900. Serial No. 7,197. (No model.)

To all whom it may concern:

Be it known that I, AXEL H. HELANDER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia, State of Pennsylvania, have invented an Improvement in Condensers, of which the following, taken in connection with the accompanying drawings, is a full and clear specification.

My invention relates to improvements in condensers for condensing steam and other vapors whereby the quantity of water required for said condensation is reduced to a minimum.

Generally stated, there are two types of condensers, the one known as "surface condensers" and the other as "jet-condensers." There are also two types of jet-condensers, the one known as "wet-air-pump condensers" and the other as "dry-air-pump condensers." My invention is particularly applicable to the latter type, wherein the steam to be condensed is brought into actual contact with the water for condensation and the air and vapor liberated drawn away by an air-pump.

As usually constructed jet-condensers are not provided with any device for regulating the vacuum in keeping with the quantity and temperature of water for condensation and the steam to be condensed. For a given vacuum the quantity of water for condensation will vary with the temperature of said water and the quantity of steam to be condensed. If the quantity of water for condensation is too much, there is a waste of power in the pumping of said water.

The object of my invention is to provide devices whereby the condenser may be so regulated that for the quantity of steam to be condensed and for the temperature of the water for condensation the vacuum produced by the condensation of said steam may be maintained at or nearly at the theoretical vacuum with the minimum quantity of water. I attain these results by means of the apparatus illustrated in the accompanying drawings, in which—

Figure 1 is a section through a condenser plant, showing the condenser-tower with auxiliary machinery. Fig. 2 is a section of the vacuum-tank on a larger scale. Figs. 3 and 4 show sections, respectively, on lines A B and C D of Fig. 2. Figs. 5 and 6 show a different arrangement of valves.

Similar characters refer to similar parts throughout the several views.

Referring to Fig. 1, A is the pipe for leading the exhaust-steam from the engines to the condenser vessel B, having tail-pipe M. Vessel B may be made circular, rectangular, or of any shape. The water for condensation of the steam conveyed by pipe A is taken from any source L by pipe D and pump C and discharged into condensing vessel B at F through the medium of pipe E. N, O, and P are deflecting-plates located within condensing vessel B, forming pans and intended to distribute the water. G is an air-pump connected by pipe H to the air-tight vacuum-tank I, which is in turn connected to the top of condensing vessel B at K by pipe J. Q is a valve-controlling connection between vacuum-tank I and pipe D through pipe S. R is a valve-controlling connection between vacuum-tank I and the atmosphere and operated by the motion of valve Q through rod T. Valves Q and R are shown in larger scale in Fig. 2. A valve U controls communication between the atmosphere and pipe J. V is a tank or hot-well at the foot of M, and X is the overflow from hot-well V.

The action of the water within condensing vessel B and tail-pipe M when introduced into condensing vessel B by pipe E is as follows: The water overflows the pan formed by deflecting-plates N and passes into pan formed by plates O. The latter pan is perforated on its sides and bottom, and a portion of the water passes out through these perforations and the remainder overflows the edges. The former water passes in turn to tail-pipe M and the latter water to the pan formed by the plates P, whence it overflows into tail-pipe M. As is evident, the water is divided into relatively-small volumes and is brought into intimate contact with the steam entering condensing vessel B by pipe A.

The operation of my invention is as follows: Assuming that water is being discharged into condensing vessel B by pipe E and the steam is being discharged into condensing vessel B by pipe A, when the volume and temperature of the water bears a proper proportion to the quantity of steam introduced, it is evident that said steam will be condensed and the combined volume of water for condensation and the water of condensation pass into tail-pipe M, thence into hot-well V, and thence away through overflow X, a vacuum being formed in the meantime in condensing vessel B and tail-pipe M and the air and vapor liberated in condensing vessel B being removed by the action of pump G through pipe J, vacuum-chamber I, and pipe H. According as the vacuum is greater or less so will the level 1 2 of water in tail-pipe M be higher or lower. It is a well-known fact that the higher the temperature of the water for condensation the greater the quantity of water required to produce any given vacuum, the quantity of steam remaining the same. It is also well known that the nearer the quantity of water for condensation approaches the theoretical the greater the quantity of vapor liberated. This vapor is removed from the condensing vessel B by air-pump G, said pump serving at the same time to remove from the condensing vessel B any air that may enter with the water.

As already explained, it is desirable that for a given temperature of water for condensation and a given quantity of steam the minimum quantity of water necessary to create the desired vacuum be employed. The theoretical quantity is that which is just sufficient to create the desired vacuum, and it is evident that if the quantity of water supplied is less than the theoretical the steam entering condensing vessel B through pipe A will vaporize the water entering at F through pipe E. Assuming the latter condition, condensing vessel B would be filled with vapor which would be drawn away from condensing vessel B through pipe J at K by the action of the air-pump G creating a vacuum in pipe H, vacuum-chamber I, and pipe J. This vapor in passing through pipe J and vacuum-chamber I would be condensed to a considerable extent, owing to the cold surfaces of pipe J and vacuum-chamber I, the water formed by said condensation being accumulated in the bottom of vacuum-chamber I. Now the assumed condition means that the quantity of water for condensation is too small for the vacuum to be maintained, whereas it would be sufficient for a less vacuum. Therefore when the assumed condition prevails it is evident that if we can automatically reduce the vacuum the condition will be overcome. As last stated, the condensed water accumulates in the bottom of vacuum-chamber I. By referring to Fig. 2 there will be seen a hollow air-tight sphere or valve Q, having its seat W on the extension of pipe S. Valve Q is connected to valve R by stem or rod T, said valve R having a cylindrical middle portion fitting inside of cylindrical casing Y, the latter having a seat 100 for the upper portion of valve R. The lower portion of valve R is tapered or conical as indicated. Z are guides directing the line of movement of valve Q and brought together at 200 to form a guide for rod T. As the water accumulates in vacuum-chamber I the float-valve Q is raised, thus raising valve R and admitting air to vacuum-chamber I, whereby the vacuum is reduced and also allowing the accumulated water in vacuum-chamber I to be drawn away through pipe S by the action of the pump C. From the foregoing it is evident that valve Q acts as an automatic regulator to maintain the vacuum at nearly the theoretical point for the quantity and temperature of water for condensation supplied and the quantity of steam to be condensed. In other words, if the speed of the air-pump and water-pumps is so adjusted that a slight decrease in the quantity of water for condensation and a slight increase in the quantity of vapor removed from B will result in the action of valve Q and a consequent reduction in vacuum we know that the quantity of water supplied to the condenser approaches very nearly the theoretical quantity of water for the particular temperature at which the water enters the condenser and the particular quantity of steam to be condensed.

The object and aim of the apparatus being to use the least possible quantity of water for condensation, there will be under ordinary conditions a certain amount of vapor in condensing vessel B, which vapor is removed by the action of pump G. This vapor condenses in vacuum-chamber I, and it is therefore desirable that valve Q open before valve R, so that the condensed vapor due to ordinary conditions may be removed without lowering the vacuum by the opening of valve R. When the vapor increases beyond the desirable point, the quantity of condensed vapor in I increases and the valve R should open, thus reducing the vacuum, and consequently the amount of vapor liberated. In order to meet the foregoing requirements, the lower portion of valve R is made tapered or conical, as indicated, whereby the valve R may move vertically a certain distance before opening is made to the atmosphere. In the arrangement shown the latter opening will not be made until the valve R is raised to a point where the tapered part of R rises above seat 100.

Under certain conditions it might be impossible to run the air-pump G slow enough to take only the requisite quantity of vapor away from condensing vessel B. To meet this condition, a valve U is provided in pipe J, which may be opened to suit requirements and whereby a portion of the requirement of pump G is taken from the atmosphere and the remainder from condensing vessel B.

Figs. 5 and 6 show another arrangement of tank I and valves controlling communication between tank I and the suction-pipe D of pump C and between the tank I and the atmosphere. In this arrangement pipe J enters tank I at the top, while H is the pipe leading to air-pump G. A hollow ball or sphere 10 acts as a float and rises or falls as the water rises or falls in the bottom of I. Sphere 10 is attached to a lever 11, supported by posts 16 and pivoted by pin 17. Water-outlet valve 12 controls the opening 26 leading to pipe S, and is supported from lever 11 by pins 14 and 15 and rod 13. Pin 18 is provided on the opposite end of lever 11 from 10, working in slot 20 in the end of rod 19. 21 are guides for rod 19. Air-inlet valve 24 controls opening 25, leading from the atmosphere to tank I, and is connected to rod 19 by pin 23. The operation of this arrangement is as follows: When water accumulates in the bottom of I, the float 10 rises, thus raising valve 12 and allowing the water to be drawn away from tank I by the suction of pump C. Owing to slot 20 valve 24 is not moved until after the valve 12 has been opened. When pin 18 reaches the bottom of slot 20 and sphere 10 continues to rise, valve 24 is opened through the medium of rod 19 and air is admitted to tank I through opening 25. Slot 20 may be omitted and connection between lever 11 and rod 19 made by pin 18, passing through a hole of about equal size with 18 in the end of rod 19. In this case valves 12 and 24 may be made to open at the same time. In the foregoing-described arrangement of water-outlet and air-inlet valves both valves are operated by one float. It is evident, however, that a separate float may be attached to each valve and the operation of the one thus made independent of the other.

I do not limit my invention to any particular form or design of condenser vessel, tail-pipe, or other accessories thereto.

I do not limit my invention to any particular form of what I term the "vacuum-tank" I, provided only that it shall be air-tight.

I do not limit my invention to any particular design or number of valves within said vacuum-tank, provided only that they are caused to operate by the rise and fall of the accumulated water in said tank.

I do not limit my invention to method described and illustrated for removing the accumulated water in the bottom of the tank by the suction of the pumps. A separate pump may be provided for this purpose or any other device may be used.

By the term "condensing vessel" I mean the vessel or chamber B in which the steam to be condensed and the water for condensation are brought into contact without limitation as to shape, dimensions, or interior arrangement.

I prefer to call the vacuum-tank I the "vacuum-chamber."

I wish it understood that any form of air-pump may be used and, further, that any other device instead of an air-pump may be employed, provided only that it creates the necessary vacuum in tank I.

I wish it understood that any form of pump for supplying the water for condensation to the condenser may be used. Where the water will flow into the condenser vessel without the intervention of a pump, the latter may be omitted.

Having fully described my invention, what I claim, and desire to cover by Letters Patent, is—

1. In a condenser, the combination of a condensing vessel, means for delivering the vapor to be condensed and the water for condensation to said condensing vessel, a connection between said condensing vessel and a vacuum-chamber within which chamber a vacuum is maintained by suitable means, a water-outlet opening or openings in said chamber through which water accumulated in said chamber passes out of said chamber, an air-inlet opening or openings in said chamber through which air is admitted into said chamber, a valve or valves controlling said water-outlet opening or openings and operated by the rise and fall of the water accumulated in said chamber and a valve or valves controlling said air-inlet opening or openings and operated by the rise and fall of the water accumulated in said chamber.

2. The combination of a condensing vessel, a vacuum-chamber connected therewith and an air-inlet to said vacuum-chamber automatically controlled by the level of the water in said vacuum-chamber.

3. The combination of a condensing vessel, a vacuum-chamber connected therewith and an air-inlet to said vacuum-chamber controlled by movement of a water-valve in said vacuum-chamber.

4. The combination of a condensing vessel, a vacuum-chamber connected therewith; an air-inlet to said vacuum-chamber controlled by the level of the water in said vacuum-chamber and a second air-inlet to said chamber from the atmosphere.

5. The combination of a condensing vessel, a water-pump connected with said vessel, a vacuum-chamber connected with said vessel, an air-pump connected with said vacuum-chamber and an automatically-operated air-inlet to said vacuum-chamber.

6. The combination of a condensing vessel, a water-pump connected with said vessel, a vacuum-chamber connected with said vessel, an air-pump connected with said vacuum-chamber and an air-inlet to said vacuum-chamber automatically operated by the level of the water in said chamber.

7. The combination of a condensing vessel, a water-pump connected with said vessel, a vacuum-chamber connected with said vessel, an air-pump connected with said vacuum-chamber and a water-outlet for said vacuum-chamber, a valve for said outlet which valve automatically controls the admission of air to the vacuum-chamber.

8. The combination of a condensing vessel, a vacuum-chamber connected therewith, a water-outlet for said vacuum-chamber, an air-

inlet to said chamber, a valve for said air-inlet and a valve for said water-outlet, which valve by a progressive movement first opens the water-outlet and then the air-inlet.

9. The combination of a condensing vessel, a vacuum-chamber connected therewith, a water-outlet to said vacuum-chamber, a valve for said outlet, a float in said chamber, an air-inlet to said vacuum-chamber, a valve for said inlet and connections from said float to both of said valves.

In testimony whereof I have hereunto set my hand this 22d day of January, A. D. 1900.

AXEL H. HELANDER.

Witnesses:
L. K. LOCHMAN,
I. G. BAYLEY.