(No Model.)

2 Sheets—Sheet 1.

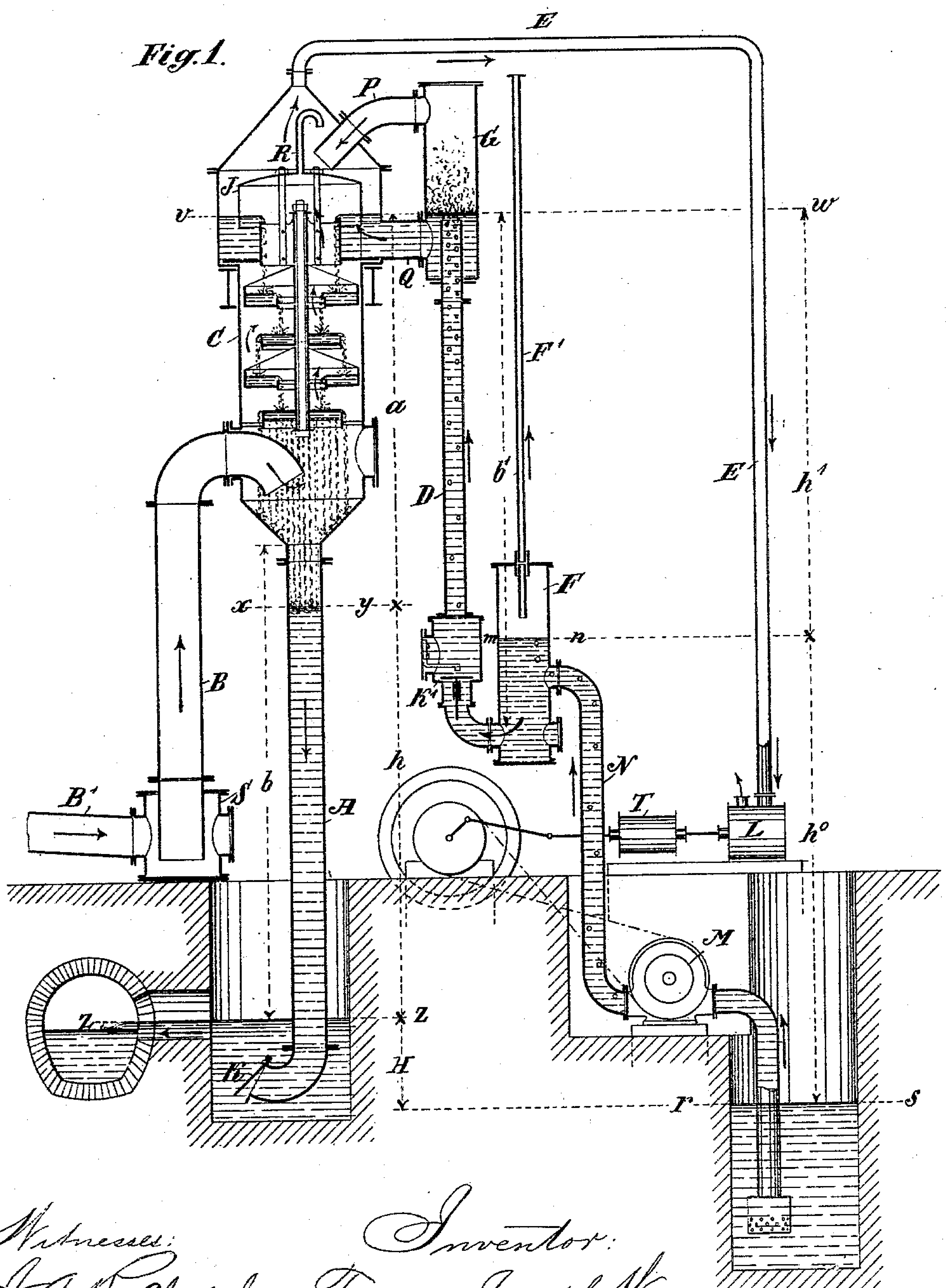
F. J. WEISS.

CONDENSER.

No. 414,618.

Patented Nov. 5, 1889.

Fig. 1.



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(No Model.)

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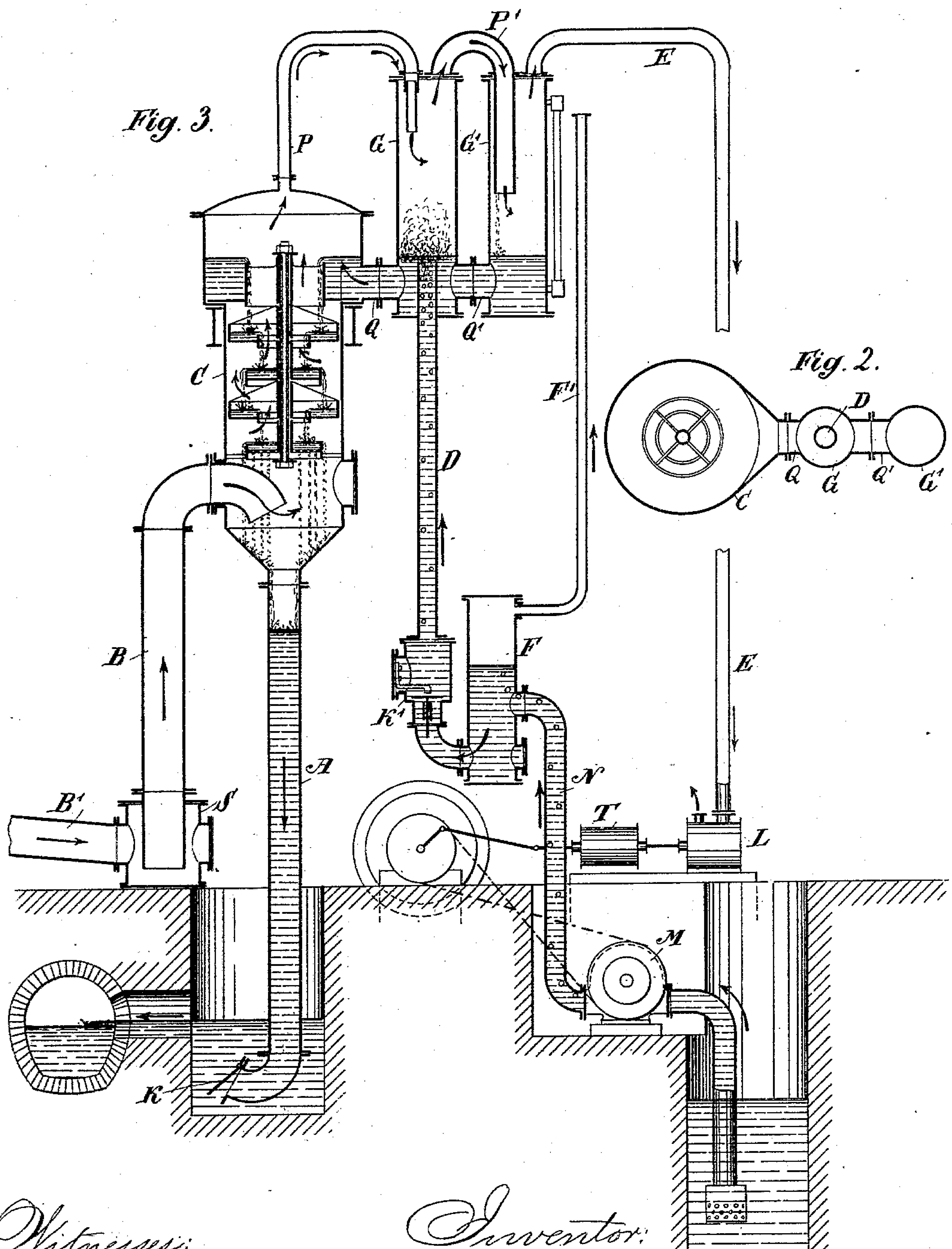

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FRANZ JOSEPH WEISS, OF BASLE, SWITZERLAND, ASSIGNOR OF ONE-HALF TO THE SANGERHÄUSER ACTIEN-MASCHINEN-FABRIK AND EISENGIESSEREI, VORMALS HORNUNG & RABE, OF SANGERHÄUSEN, GERMANY.

CONDENSER.

SPECIFICATION forming part of Letters Patent No. 414,618, dated November 5, 1889.

Application filed January 31, 1889, Serial No. 298,258. (No model.) Patented in Germany November 6, 1886, Nos. 39,345 and 40,160, June 5, 1887, No. 41,480, and August 5, 1888, No. 46,467.

To all whom it may concern:

Be it known that I, FRANZ JOSEPH WEISS, of the city of Basle, in the canton of Basle and Republic of Switzerland, have invented a certain new and useful Improvement in Condensers, (for which I have obtained Letters Patent in Germany, No. 39,345 and No. 40,160, dated November 6, 1886, No. 41,480, dated June 5, 1887, and No. 46,467, dated August 5, 1888,) of which the following is a specification, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention relates to an improvement in condensers, and more particularly to that type of condensers known as "counter-stream condensers;" and the objects of my invention are to attain the highest possible results by employing the smallest possible means—that is to say, first, the least possible consumption of cooling-water by reason of the counter-stream principle adopted; second, the smallest possible air and cold-water pump, likewise by reason of the counter-stream principle; third, the least possible work for effecting the condensation, partly likewise as a result of the counter-stream principle employed and partly by reason of the novel mode of feeding the cold water to the condenser, which results in obtaining permanently the full suction-power of the latter; fourth, the most energetic condensation of the vapors by keeping away from the condensing-chamber proper the air having been absorbed in the cooling-water; fifth, the most uniform operation of the condenser by obviating or preventing the dropping of the water, drawing empty the cold-water receptacle, forcing over water into the air-pump, and the returning flow of water into the steam-feeding pipe.

In the accompanying drawings, illustrating the improved means by which the above-mentioned results are obtained, Figure 1 is an ideal vertical section of my improved condensing plant; Fig. 2, a horizontal transverse section of the upper part of the body of the condenser; and Fig. 3, a modification hereinafter referred to.

The steam to be condensed enters through the pipe B into the lower part of the body of the condenser C, in the upper part of which the cooling-water is forced through the pipes N F D Q by means of the cold-water pump M, so that the said water will flow against the rising steam. The air-pump L draws the air from the upper part of the condenser, said part being the coldest. By reason of the latter circumstance the steam in the mixture of gas there prevailing—that is to say, mixture of air and steam—will be condensed already, with the exception of only quite a trifling remainder, so that the dry-air pump L will draw off nearly pure air, instead of drawing off unnecessarily steam. The volume of the said pump may, therefore, be the smallest and the power required for working the same the least possible. The water falling in the form of cascades into the lower part of the condenser will be heated to the temperature of the steam entering the latter. The cooling-water thus being made use of with the best possible results, can therefore be employed in the smallest quantities possible, so that for this reason the cold-water pump M may likewise be of the smallest dimensions possible and will require but little working power. There is another reason for such minimal power being necessary for operating the said pump, which will be explained presently. The heated water leaves the condenser through a waste-pipe A, measuring at least thirty-three feet in height and emptying below the water-level.

The cold-water pump forces its water through pipe N into a vessel open at the top and consisting below of a wide pipe F and above of a narrow tube or pipe F′, extending from the latter and open at the top. Hereinafter I shall refer to this part of apparatus as the "vessel F."

The condenser draws its water automatically from the vessel F through the pipes D and Q, and it is evident that the water-level $m\ n$ will at times adjust itself automatically below the upper water-level $v\ w$ to an extent corresponding to the vacuum at the time prevailing in the condenser. The cold-water pump, therefore, need not lift its water to the full height h^0+h^1, but need to lift it only to the least necessary height h^0, for the reason that the full suction-power of the condenser is always made use of, which fact constitutes the other reason for the minimal amount of power required for the said pump, as hereinbefore referred to.

In order to prevent the condenser from ever drawing empty the vessel F, it is necessary that the point at which the suction-pipe D enters the lower part of the said vessel should be for at least the height of the water-barometer (that is, about thirty-four feet) below the upper water-level $v\ w$—that is to say, the vertical distance b' should be equal to at least 33.9 feet. When so arranged, in case of the cold-water pump M failing once to feed water to the intermediate vessel F, the latter could not be drawn empty, the result in such case being simply that a column of water would remain hanging motionless within the suction-pipe D. On the other hand, if the condenser should have lost temporarily its suction power — as, for instance, in the case of its having become hot—then it would drop or let fall its water, and in such event a common condenser intended to draw its water automatically would never become operative again by itself. In the present case if the condenser has become hot, and for this reason has dropped its water while air-pump L and cold-water pump M are continuing to do their work, the water-level will rise in the pipe F and then in the tube F′, as well as in the pipe D, until it reaches the upper part of the condenser, (for which reason the tube F′ will have to extend beyond the top of the latter,) when the cooling-water will flow spontaneously into the condenser, thus cooling the latter and causing a condensation again of the vapors entering through pipe B, while the vacuum increases. The water-level $m\ n$ descends of its own accord, and the cold-water pump M will have to lift its water only to the normal height h^0 again, while before the water was to be raised temporarily by the said pump M to the greater height h^0+h^1.

Since the cold-water pump should be enabled to lift the water to different heights without changing its speed, such pump must be a piston or similar pump and not a centrifugal pump.

A controlling device—such as a cock, valve, throttle-valve, &c.—for controlling the quantity of cooling-water admitted must not be applied in the feed-conduit for the cold water, since such appliance would at once bring to nothing that object of this invention which consists in attaining a minimal amount of power for working the cold-water pump. Any change in the quantity of the cold water admitted is to be caused only by the pump M itself, either by changing the speed, or, in the case of piston-pumps, also the stroke of the latter.

The pipe N enters the intermediate vessel F a short distance above the lower end of the pipe D, so that air introduced or leaking into the cold-water pump or its suction-pipes cannot be taken off with the cooling-water into the condenser, but is bound to part in the shape of bubbles from said water within the vessel F and to escape into the atmosphere through the tube F′, open at the top.

It will happen in the use of condensers of this type that water will flow back into the steam-feeding pipe and thereby cause disturbances, notwithstanding the fact that the waste-pipe A has been made considerably longer than the height of the water-barometer b, or about thirty-four feet. Such occurrence will be due to the vertical fluctuations of the column of waste water suspended or floating within the pipe A, and these fluctuations may be brought on by any influences—as, for instance, by small changes in the pressure prevailing in the condenser, it being known to anybody that the mercury-column of a common barometer will be caused to fluctuate up and down in case of the latter being knocked against or moved but a little. I obviate such fluctuations of the water in the pipe A by arranging in the latter at any suitable point thereof, preferably near the lower end of the same, a back-pressure clack or check valve K. In case of there being now a tendency for vertical fluctuations to set in, the check-valve, although allowing the increased quantity of water to leave the pipe at the fluctuation in the downward direction, will close at the starting-upward fluctuation, and thus prevent the said fluctuation taking place. By these means disturbing fluctuations are avoided in the waste-pipe A, the water-level $x\ y$ remains tranquil, the quantity of water leaving the pipe A equals the quantity entering the same simultaneously, and no water can flow back into the pipe B.

Since thus the water-level $x\ y$ of the running-off warm water is made to remain tranquil, it is evident that there can never be an occasion for any part of this said warm waste water being drawn into the dry-air pump L through the pipe E connecting with the top of the condenser. Should it nevertheless happen that the dry-air pump L would draw water through the pipe E, such water could be fresh water only entered near the top—that is to say, cooling-water entered in a cold state—in contradistinction to the waste water running off in a warm state below; but such cold water entering would have the same disturbing effect as hot water drawn into the pipe E, since the pump L has been constructed not to transmit water (that is, liquids,) but to draw gases only, (that is, air and some steam.) The drawing of such cold water into the air-pipe E, and through the latter into the air-pump L, could be due to two causes—that is to say:

a. It is possible that the column of water suspended in the suction-pipe D be caused to fluctuate in a vertical direction, (the same as this has been set forth hereinbefore in respect of the column of water in the pipe A,) and that in consequence of such fluctuation in an upward direction the quantity of water entering the upper part of the condenser be increased to such an extent as to prevent the water (in spite of applying large sectional areas) from falling down fast enough, and thus to cause the said water to fill up the upper part of the condenser until its level reaches the pipe E, when the air-pump L will commence drawing it off. Vertical fluctuations of this sort setting in within the suction-pipe D are prevented, the same as described with reference to the waste-pipe A, by arranging an automatic check or back-pressure valve K′ somewhere within the said suction-pipe, preferably near the lower end of the same, said valve closing at the commencement of the return motion of the column of suction-water thrown upward by the fluctuation. The said valve closing thus prevents the threatening downward fluctuation and thereby the subsequent upward fluctuation which would have followed the former. By the arrangement, as described, of the two check or back-action valves K and K′, whose functions may be compared best to those of pawls, all and any fluctuation of the water within the condenser not intended and not controllable from the outside is avoided—or, in other words, the non-desired actions of the masses of the "*viribus vivis*," or "live forces," contained in the moving water-columns are prevented by the said valves from setting in.

b. The other possible reason that may account for drawing over into the air-pump cooling-water entered the condenser in a fresh state, consists in the bubbling or boiling up of the said cooling-water conducted directly and immediately into the condenser through the suction-pipe D, said water containing, like any water in its native state, a considerable quantity of atmospheric air absorbed therein. As the water rises in pipe D, the pressure bearing thereon will decrease the more the water gets to the top, and quite near the top it is only the much-reduced pressure (that is, the "vacuum") prevailing within the condenser that bears upon the said water. The consequence thereof will be that while the water is rising in the pipe D the air absorbed therein will be set free in an increased measure in the form of bubbles, said bubbles increasing in number toward above, so that there will not be a compact quantity of water, but an emulsion of air and water bubbling or boiling up violently, escaping at the upper end of the pipe D. (For the sake of explanation attention may be drawn to the well-known fact, according to which a glass of water placed underneath the recipient of an air-pump will likewise boil up or bubble violently by reason of the absorbed air being liberated under the reduced air-pressure.) Now, if the cooling-water, or, in other words, the said emulsion of air and water, is introduced directly into the condenser through the pipe D, then it may easily occur that the bubbling or boiling up of said water will continue upward as high as the pipe E, in which case the air-pump L would again draw in water. In order to avoid this, I do not introduce the cooling-water from the suction-pipe D into the condenser C direct, but let it enter first a space G, which I propose hereinafter to term "air-separator," and which is closed on all sides, except where it connects with the body of the condenser C by means of the pipes Q and P. The upper end of the pipe Q is arranged below the upper water-level *v w* within the condenser and air-separator, so that a trap or water-closing is formed, preventing the air contained in the upper part of the air-separator G from entering the condenser through the pipe Q. The pipe D extends within the air-separator up to near or somewhat above the upper edge of pipe Q. Thus it is evident that the bubbling or boiling up of the water or the liberating of the absorbed air will now take place entirely within the air-separator G, and that only water freed of air will enter the condenser through the pipe Q. Such water will not boil up any more within the condenser, so that there is no occasion for the air-pump to draw in water from the latter. The air liberated in the air-separator G enters the condenser through the upper pipe P, and is thence sucked off by the (dry) air-pump L. The water that may have been taken along from the air-separator through pipe P will fall down in the upper part of the condenser, the said pipe being arranged to this end in an inclined position, so that it serves, moreover, as a "water-separator." Supposing, now, the condenser were provided only with the devices so far described, then the air set free within the air-separator G, and before that, having been absorbed in the water, would enter the space of the condenser direct through the pipe P, increase considerably the amount of air there already contained, and either having leaked in or being introduced with the steam through pipe B, and thus deteriorate the process of condensation, it being a known fact that the presence of air (or non-condensable gases) will always be a drawback to condensation, and that the more the more air is present, for the reason that the said air will surround and protect with an insulating-jacket the molecules of steam intended to become condensed by the contact with the cooling-water.

In order to prevent from entering the actual space of condensation, at least that amount of air which has been absorbed in the cooling-water and constitutes the largest portion of the air impairing the condensation, I have made an additional arrangement, so that none but the very small amount of air leaking in or entering with the steam will be present in the said space. To this end I have arranged in the upper part of the condenser an inverted box or dome J, diving with the edge of its open lower end in the water within the condenser, so that fresh cooling-water is free to enter the latter underneath the said edge of the dome J, while the air above the latter cannot any more penetrate into the space of condensation proper, but is removed directly to the air-pump L through the pipe E. The dome J must not be closed above, since in such case air leaking into the lower part of the condenser would force its way through underneath the lower edge of the dome into the space above the latter, and by doing so would cause again a boiling up of the water to be avoided. For this reason I have provided the upper side of the dome J with a small opening connecting with a tube R, preferably bent down near its upper end, said tube permitting the said air from the lower part of the condenser to pass into the upper part, while air is prevented from returning in the opposite direction, since there is always a current in an upward direction prevailing in the tube R for the time of the air-pump being in operation.

It will be understood that the specific means for carrying into effect my invention allow of being modified in many respects without departing from the nature of my said invention, which consists, as will have been seen, in providing for freeing the water from its air before the former enters the condenser and preventing the air which has been absorbed in the said water from entering the actual space of condensation. Fig. 3 of the drawings gives an instance of one of such modifications. The cooling-water rising in the suction-pipe D does not in this instance enter the condenser C directly, but is introduced preliminarily into an air-separator G in a manner similar to that described with reference to Fig. 1 of the drawings. The air liberated in the air-separator is not though, as in the former instance, allowed to pass into the upper part of the condenser, but is conducted through a pipe P′ into a separate special water-separator G′, communicating near its lower end with the air-separator G by means of a pipe Q′, the air borne along with the steam or having leaked into the condenser C being conducted by means of the tube P into the upper part of the air-separator G, whence it passes, together with the absorbed air there liberated, into the water-separator G, through pipe P′, and is drawn off by the air-pump L through pipe E.

I wish it to be distinctly understood that I do not confine myself to the specific arrangement of apparatus as illustrated in the accompanying drawings, and that the nature of my invention embraces any condensing apparatus wherein provision is made for allowing the cooling-water to boil up—that is to say, to be freed of its contained air in a space separated by a water-closing from the space of condensation proper and for preventing the air from being drawn off by the air-pump from a point of the condenser or of the spaces communicating with the latter, lying directly and immediately above the said space, wherein the boiling up of the cooling-water takes place, and from passing to the said pump unless it has passed first some suitable water-separator.

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

1. In a condenser, the combination, with a cooling-water conduit, of a vessel connected with the conduit between the latter and the condenser and having an upwardly-extending tube open at its top for the escape of atmosphere from the water in said vessel and for the rise of water therein if the condenser drops its water, substantially as described.

2. In condensers, the combination, with the cooling-water conduit, of an air-separator to free the cooling-water of the absorbed air by passing the water through said separator before its entrance into the condenser, substantially as and for the purposes specified.

3. In condensers, the combination, with the cooling-water conduit, of an air-separator to free the cooling-water of its absorbed air by passing the water through said separator before its entrance into the condenser, and a water-closing between the latter and the air-separator, substantially as and for the purposes specified.

4. In condensers, the combination, with the cooling-water conduit, of an air-separator to free the cooling-water of its absorbed air by passing the water through said separator before its entrance into the condenser, a water-closing between the latter and the air-separator, and a water-separator, substantially as and for the purposes specified.

5. In condensers, the combination, with the cooling-water conduit, of an air-separator to free the cooling-water of its absorbed air by passing the water through said separator before its entrance into the condenser, a connecting-pipe between the latter and the upper part of the air-separator, and a dome J within the upper part of the condenser, constructed and arranged substantially as and for the purposes specified.

6. In condensers, the combination, with the cooling-water conduit, of an air-separator arranged in the suction-conduit between the condenser and the air-pump and receiving the cooling-water before its entrance into the condenser, substantially as and for the purposes specified.

7. In condensers, the combination, with the cooling-water conduit, of an air-separator arranged in the suction-conduit between the condenser and the air-pump and receiving the

cooling-water before its entrance into the condenser, and a water-separator G′, substantially as and for the purposes specified.

8. In condensers, the pipes containing the columns of waste water and of suction-water, in combination with the check or back-action valves, substantially as and for the purposes specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANZ JOSEPH WEISS.

Witnesses:
GEORGE GIFFORD,
CHS. A. RICHTER.