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ART OF CONDENSING STEAM OR COOLING FLUIDS.

(Application filed Apr. 8, 1901.)

(No Model.)

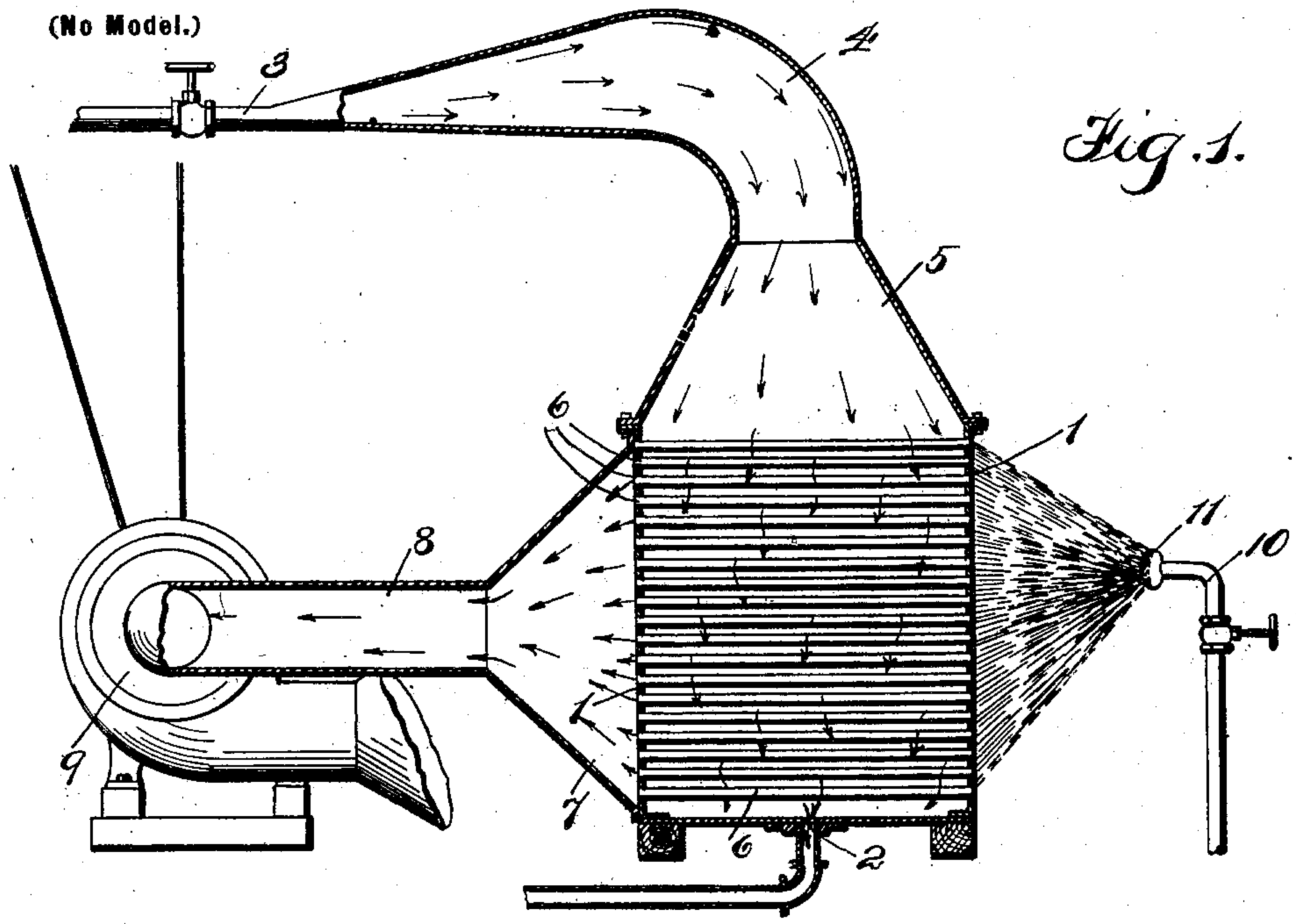

Fig. 1.

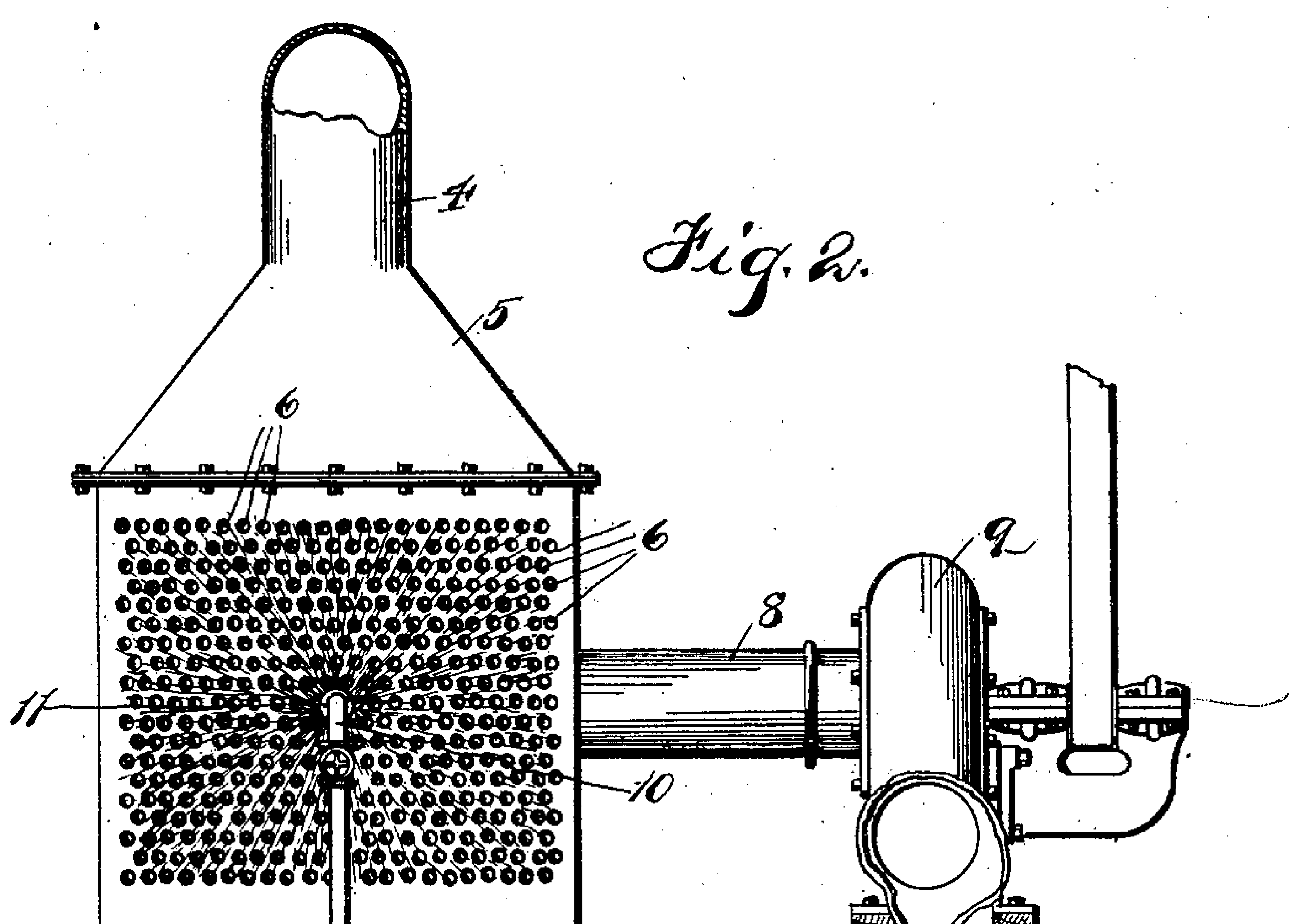

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ART OF CONDENSING STEAM OR COOLING FLUIDS.

SPECIFICATION forming part of Letters Patent No. 705,321, dated July 22, 1902.

Application filed April 8, 1901. Serial No. 54,827. (No specimens.)

To all whom it may concern:

Be it known that I, THOMAS M. COLWELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in the Art of Condensing Steam or Cooling Fluids, of which the following is a full, clear, and exact specification.

This invention relates to the condensing of steam or to the extraction therefrom of a sufficient number of heat units to convert it into water, and to the cooling of fluids generally. This result has heretofore been obtained in a greater or less degree in various ways—as, for example, the direct injection of cold water into the steam to be condensed, the contact of the steam with one side of a surface on the other side of which impinges a cooling medium, such as water or air, and the contact of the steam with one side of a surface on whose other side is performed some method of rapid evaporation—such, for example, as the evaporation of water by the heat of the steam to be condensed, usually aided by a current of air; but these prior methods are only partially efficient, and in each instance, whether the cooling agent be water or air, the result is produced only at the expense of an amount of the cooling agent vastly disproportionate to the amount of water of condensation obtained; and where cooling by evaporation is relied on it is of course necessary, theoretically, to evaporate at least a pound of water on the outside of the surface separating the water and steam for every pound existing on the other side in the form of steam, and in practice it requires a much greater percentage, and although the evaporating process is accelerated somewhat by the air-current, and the air itself possesses a certain degree of heat conductivity, it is necessary, nevertheless, in order to obtain adequate results by the latter as well as by all other prior methods to employ very extensive condensing-surfaces and comparatively large volumes of the cooling agent, thus making the condensing apparatus and the amount of cooling agent employed greatly out of proportion to the product of the condenser, or, in short, making the product expensive. This invention is based upon a principle entirely different from all of these prior methods, and it has for its object to subject steam or other substance from which the heat is to be extracted to the action of the atmospheric element know as "aqueous vapor." It has been discovered that under certain atmospheric conditions there exists this atmospheric element which has been referred to as "aqueous vapor," and which, while apparently composed of air and water, seems to differ essentially in character and function from both of these latter, for while under ordinary conditions less than one-quarter of one per cent. of the atmosphere is constituted by this aqueous vapor, atmospheric air in which it does exist possesses about seventy times the heat-absorbing power of air which does not contain it, thus making it apparent that while its component elements are derived from water and air, it possesses vastly greater heat-absorbing powers than either of these separately or of the two combined in the form of fog or mist or spray or steam, all of which latter differ essentially from aqueous vapor, and although they all possess a much greater percentage of water than aqueous vapor, none of them possesses more than a very small degree of the heat-absorbing power of the latter. Aqueous vapor is not present in the atmosphere under all thermometric and barometric conditions, and only exists when the temperature and atmospheric pressure are right for causing the air to absorb moisture and hold it in suspension as a transparent impalpable gas or vapor; but the temperature must not be great enough to convert it into steam, for when this result takes place the aqueous vapor is destroyed, and, on the other hand, if the aqueous vapor which already exists in the atmosphere is to be utilized for condensing or cooling purposes the temperature must not be so low as to chill it, and thereby convert it into mist or fog, which has little or no heat-absorbing power. For example, it is found that by subjecting all of the steam produced by the evaporation of thirty pounds of water per hour direct from its source of production to about eighty thousand cubic feet of rarefied air per hour impregnated with steam the resultant water of condensation is but an inconsiderable amount, and, as is well known, to produce one pound of water by means of cold water in the surface condenser twenty-five pounds of the cold water will be required, or, in other words, to condense all of the steam coming direct from a twenty-five-horse-power boiler and produce seven hundred and fifty pounds of water per hour would require eighteen thousand seven hundred and fifty pounds of cooling or condensing water; but when the same amount of steam is subjected to less than two-thirds that amount of air containing aqueous vapor (but no steam) the entire volume of steam is condensed, producing seven hundred and fifty pounds of water per hour. This vastly-improved result has been arrived at not without great difficulty, for the problem has been to compel the aqueous vapor to pass into effective propinquity to the steam to be condensed and to prevent the aqueous vapor from exerting its heat-absorbing influence prematurely, or, in short, to lead it into the condenser in its virgin state to cause it to exert its power of absorbing heat after entering, and, lastly, to rapidly conduct it heat-laden away from the radiating-surfaces of the condenser before it has opportunity to give back its heat. In arriving at these desired results it is found, first, that the condition of the atmosphere in which the operation is to be performed must be such as to generate aqueous vapor—it must be warm, but not too hot, say above 50° Fahrenheit and below the boiling-point; second, the air containing the aqueous vapor must be at substantially atmospheric pressure with the aqueous vapor in a virgin state and its heat-absorbing powers unimpaired immediately prior to its conduction to the point where it is to absorb the heat, because otherwise it would have expended its heat-absorbing powers prematurely; third, the aqueous vapor must be conducted into and away from the apparatus with great velocity by an induced or attenuated instead of a compressed or forced draft. The first two of these conditions may be readily produced by means of an exhauster of suitable construction which will draw air at atmospheric pressure through the apparatus and cause it to become rarefied after entering; but it is found that no appreciable amount of aqueous vapor comes through the apparatus, and no appreciable degree of condensation is produced unless the atmosphere prior to its induction and while at normal atmospheric pressure be laden with moisture, and care must be taken as to the amount of moisture supplied, for a surplus over and above that which floats freely in the air-current detracts from rather than improves the result. It is also important that the steam or other fluid which is to be condensed or cooled be permitted to expand simultaneously with the expansion of the aqueous vapor, and while in effective propinquity to and separated from said aqueous vapor. This double and simultaneous expansion of course produces a double cooling effect—*i. e.*, that which results from the expansion of the steam, causing it to draw on the surrounding surfaces for heat, and that which results from the expansion of the aqueous vapor, causing it also to draw for heat on the surrounding surfaces.

The invention may be carried out by any simple apparatus, such as a chamber having a number of horizontally-arranged tubes passing therethrough and open freely and entirely to the atmosphere at their inlet ends, while their other ends are connected with an exhaust-fan for drawing the atmosphere rapidly through them. The steam is admitted to the chamber in a direction or current transversely of the tubes, so that the heat of the steam will be better imparted to the tubes by the impact of the steam thereagainst, and opposite the open inlet ends of the tubes the atmosphere is dampened by a very fine or atomized spray of water, care being taken to avoid any surplus of water in the inrushing current of air over and above that which floats freely therein. One and one-fourth ounces of water per thousand cubic feet of air gives good results, and temperate water gives better results than cold water. The tubes should be composed of very thin material and polished inside, so as to afford free exit of the heat-laden vapor. For the same reason it is apparent that the tubes should be straight and free from bends or obstructions.

A proper atmosphere for generating and containing the requisite amount of aqueous vapor may be obtained in very cold climates by artificial heat, while in temperate climates the atmosphere of the ordinary room or place in which the method would ordinarily be performed is sufficiently warm for the production and existence therein of the aqueous vapor.

In the accompanying drawings is illustrated an apparatus for carrying out the said invention.

Figure 1 is a vertical longitudinal section of the improved apparatus, and Fig. 2 is a rear elevation thereof.

In carrying out the invention there is employed a drum or box 1, which is steam-tight, save for the water outlet or passage 2 at the bottom intended for conducting away the water of condensation. To the upper part of this box or drum is connected a pipe 3, which supplies the drum with steam, and in order that the dynamic force of the steam may be broken before entering the drum there is preferably interposed between the end of the pipe 3 and the top of the drum a gradually-widening neck 4 and a hood or bonnet 5, into which the neck 4 discharges and which forms an upwardly-tapering top to the drum. Secured in this drum in a horizontal position are a number of tubes 6, which pass through the drum from side to side and discharge at one side of the drum into a hood 7, which is preferably conical or flaring in formation, so as to envelop the ends of all the tubes and at the same time be connected with a pipe or passage 8, leading to an exhauster 9, driven by any suitable means in such a manner as to induce a current of air through the tubes 6. The tubes 6 are composed of very thin material and are very numerous and so placed horizontally close together that they will be in a position transverse to the current of steam and not lengthwise thereof, thereby compelling the steam to impact thereagainst, and thus more effectually impart its heat to the material of the tubes, and these tubes at their ends opposite the hood 7 are entirely open to the atmosphere throughout the entire surface of that side of the drum or box 1, as clearly shown in Fig. 2, so that the atmosphere will remain at atmospheric pressure and avoid all rarefying influences of the exhauster before entering the tubes.

Arranged opposite the open ends of the tubes 6 and disposed centrally with relation to that side of the drum or box 1 is a spray-pipe 10, having a suitable rose-nozzle 11 for throwing a fine shower of water into the atmosphere adjacent to the open ends of the tubes 6. In order to obtain the desired result, this shower of water must not be so copious as to cause a surplus of water to pass into and cool the tubes 6, but should be so regulated that the air-currents passing into the tubes will take up only such portion as they can absorb, the surplus falling to the ground before entering the tubes. In practice it is found that about one and one-fourth ounces sprayed in front of the tubes for every thousand feet of air passing through the tubes is ample, and of course only a very small percentage of this amount passes into the tubes, the balance falling to the ground. It is also important that the tubes be straight and their interiors smooth and entirely free from obstructions or other formation capable of producing friction with the air-currents or of arresting particles of moisture. It is therefore apparent that the aqueous vapor existing in the vicinity of the open ends of the tubes should not only be introduced into the tubes at atmospheric pressure and before it has lost any of its absorbing properties, but should be whisked through the tubes with great velocity to guard against the retransfer of its heat to the tubes and from the tubes to the surrounding steam.

This invention should not be confounded with the condensers which depend for their cooling effect upon a spray of water and air passing through the condenser-tubes, for while both employ such spray the present invention employs it in a particular way and in such proportions of water and air as to generate aqueous vapor and utilize the heat-absorbing qualities of the latter, while the prior methods depend upon the radiation due to the rapid evaporation of the water, the present method of absorption of heat by aqueous vapor being entirely foreign to them.

Having now particularly described and ascertained the nature of the aforesaid invention and in what manner the same is to be performed, I declare that what is claimed is—

1. The herein-described method of condensing steam which consists in introducing aqueous vapor at atmospheric pressure without compression into close propinquity to but separated from the steam or other body from which the heat is to be extracted, moistening the atmosphere containing said aqueous vapor prior to its introduction, reducing the atmospheric pressure of said aqueous vapor after introduction and finally rapidly removing the heat-laden aqueous vapor, substantially as set forth.

2. The method of condensing or cooling a fluid which consists in forming aqueous vapor and passing the same in a rapidly-flowing current into close propinquity to but separated from the fluid to be cooled or condensed and simultaneously expanding and rarefying said current and conducting away the heat-laden vapor, substantially as set forth.

3. The method of condensing or cooling a fluid which consists in forming aqueous vapor and passing the same in a rapidly-flowing current in close propinquity to but separated from the fluid to be cooled or condensed and simultaneously expanding the fluid to be cooled or condensed and the aqueous vapor and finally rapidly removing the heat-laden vapor from the presence of said fluid, substantially as set forth.

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