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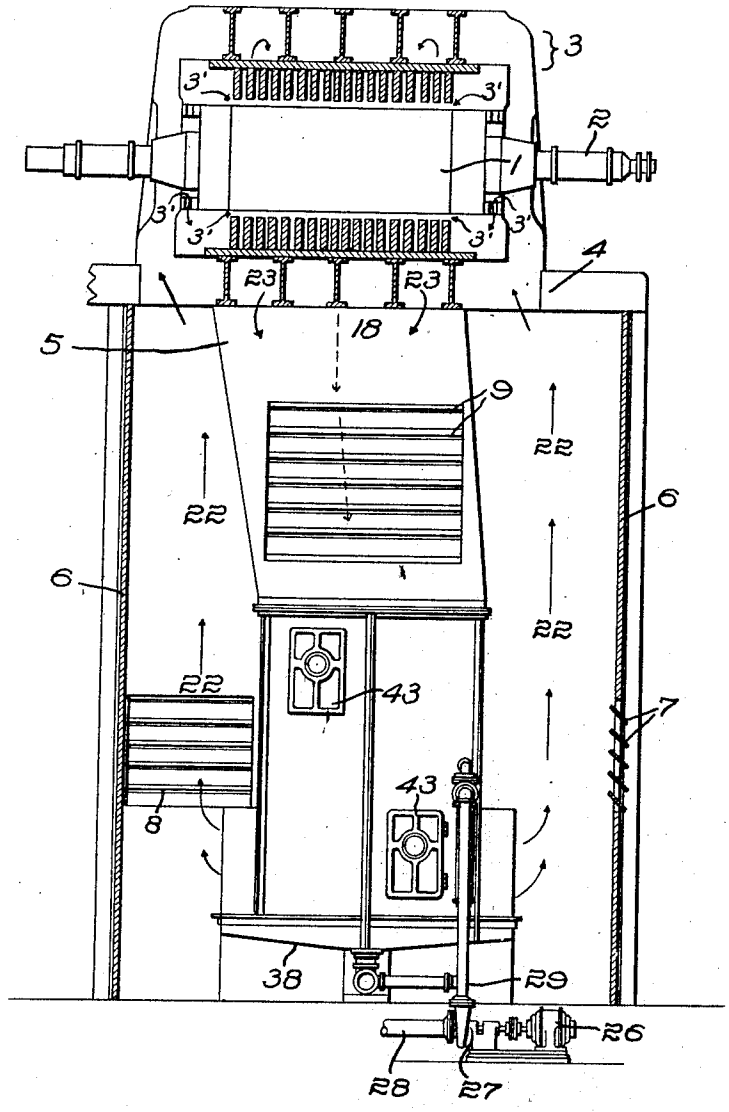
May 29, 1923. 1,457,087

J. J. PREBLE ET AL

METHOD AND APPARATUS FOR COOLING AND CLEANING AIR

Filed Sept. 13, 1920 3 Sheets-Sheet 1

Fig. 1.



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METHOD AND APPARATUS FOR COOLING AND CLEANING AIR

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Fig. 2.

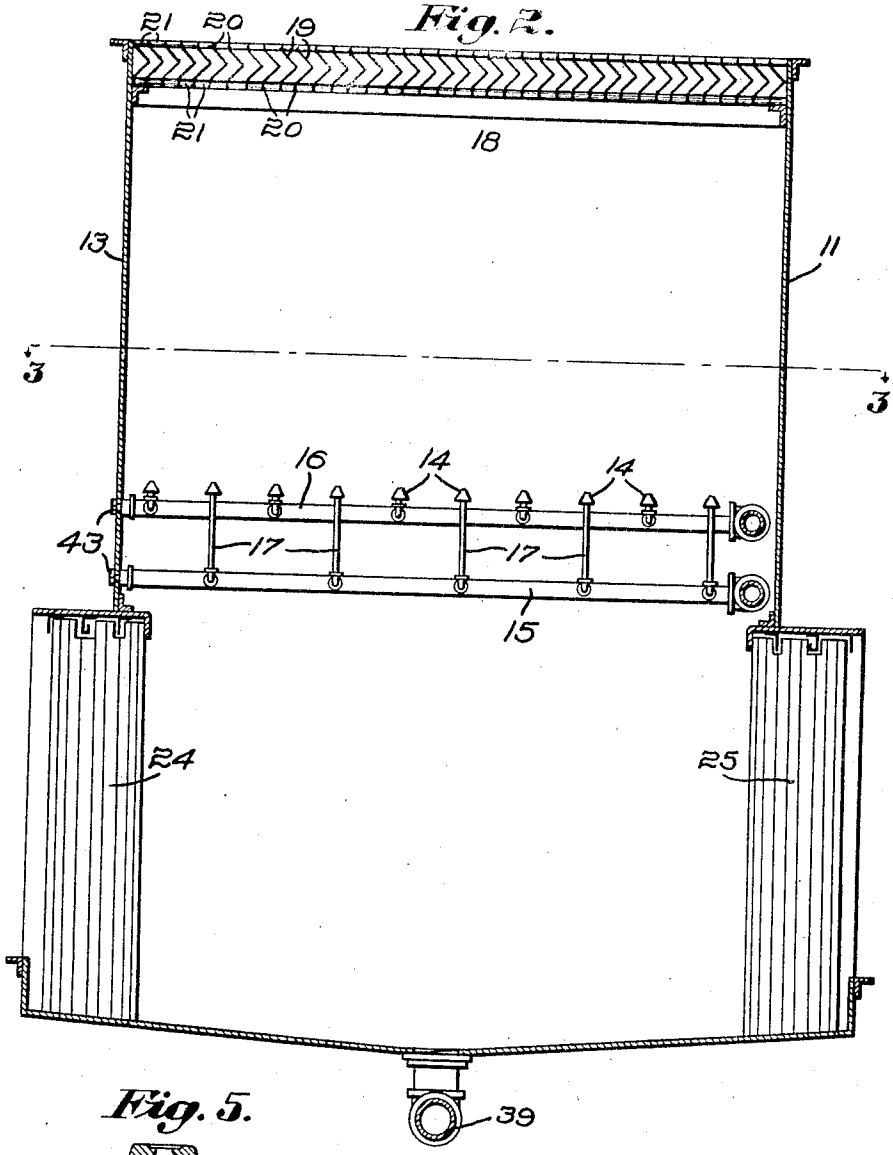
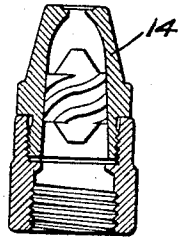


Fig. 5.



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Fig. 3.

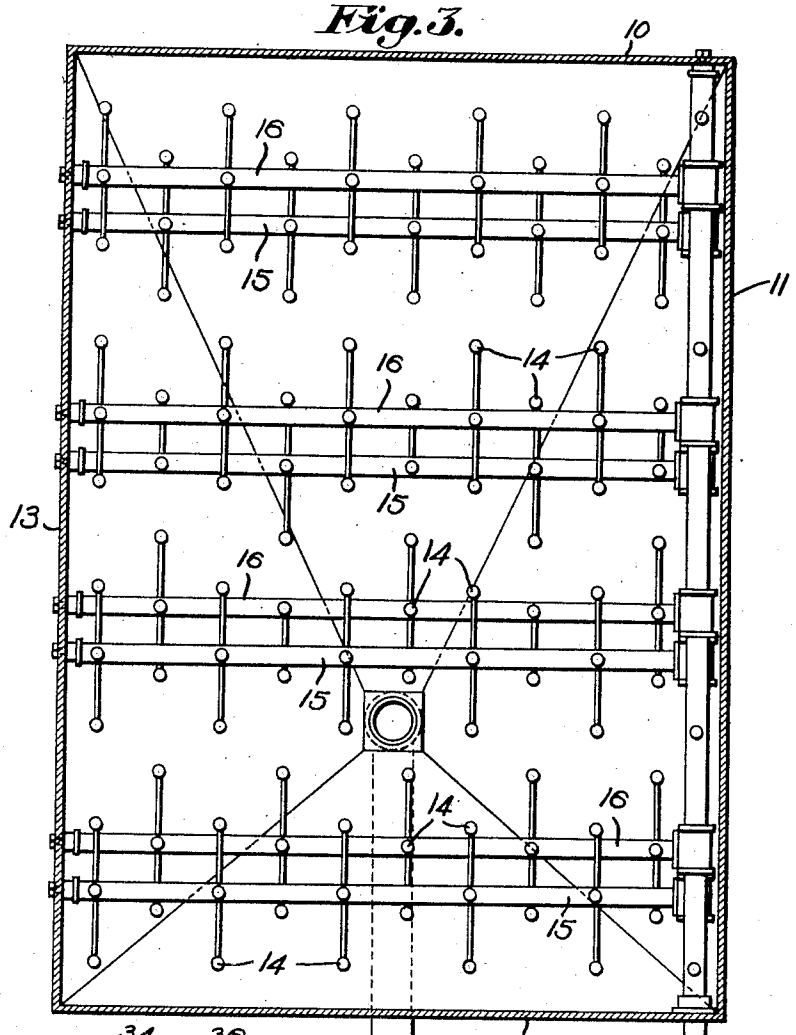
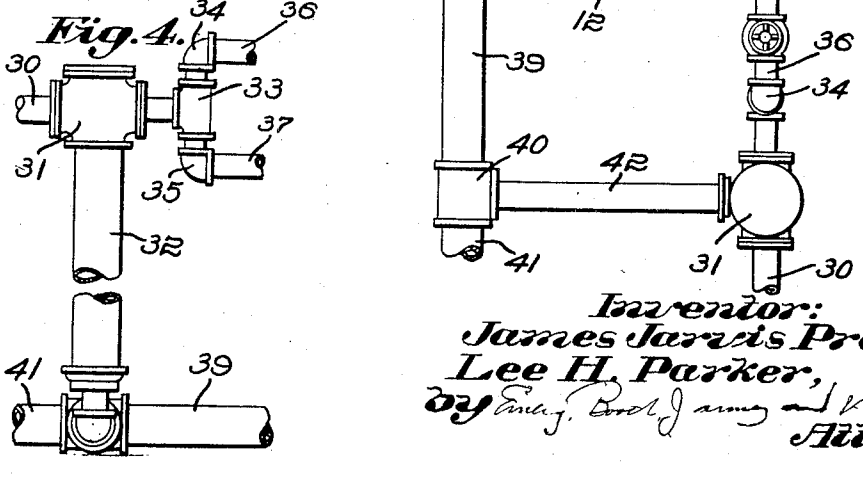


Fig. 4.



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Patented May 29, 1923. 1,457,087

UNITED STATES PATENT OFFICE.

JAMES JARVIS PREBLE, OF WALTHAM, AND LEE H. PARKER, OF BOSTON, MASSACHUSETTS, ASSIGNORS TO SPRAY ENGINEERING COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

METHOD AND APPARATUS FOR COOLING AND CLEANING AIR.

Application filed September 13, 1920. Serial No. 409,997.

To all whom it may concern:

Be it known that we, JAMES JARVIS PREBLE and LEE H. PARKER, citizens of the United States, and residents, respectively, of Waltham and Boston, in the counties of Middlesex and Suffolk, respectively, State of Massachusetts, have invented an Improvement in Methods and Apparatus for Cooling and Cleaning Air, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to methods of and apparatus for cooling and cleaning air adapted to be used for various purposes. In order that the principle of the invention may readily be understood we will set forth one embodiment of the apparatus of our invention and the best mode known to us for practicing the method or process thereof.

In the drawings:

Fig. 1 is a vertical sectional view with parts in side elevation of one type of apparatus embodying the invention and for practicing the method;

Fig. 2 is a vertical transverse section upon an enlarged scale of the lower part of the structure shown in Fig. 1;

Fig. 3 is a horizontal section upon the line 3—3 Fig. 2 and looking downward in said figure;

Fig. 4 is a detail showing the strainer and connections and looking from the right in Fig. 3 at the lower end thereof; and

Fig. 5 is a detail in vertical section of a form of spraying nozzle preferably employed in the practice of the invention.

We have discovered after much experimentation that greatly improved results are obtained by conducting or delivering the air in a substantially closed circuit through substantially upright passages or chambers or compartments and into which water or some other suitable cooling and cleaning medium is discharged. The air may be delivered either upwardly or downwardly through the passage, chamber or compartment wherein the spraying is effected but desirably and in order to accomplish the best results and as herein disclosed the air is delivered downwardly through the chamber or the like wherein spraying devices are employed that discharge the water upwardly into the descending air so that the water having reached the height or peak of the ascent, thereupon descends with or through the descending air thus greatly prolonging the period of contact of the air and sprayed water. Desirably but not necessarily, the air is circulated in a closed circuit and in such embodiment of the invention the air is circulated and recirculated a great number of times and during each circulation is subjected to the cleaning and cooling action of the sprayed water.

The provision according to our invention of a closed air circuit, particularly in connection with electrical machinery has many advantages as compared with air systems heretofore used. Atmospheric air vary generally contains dirt in varying quantities, and particularly is this true in the vicinity of factories, power plants and the like where frequently the ventilating air if obtained from outside is charged with smoke, fumes, acid vapors or other corrosive gases. Our invention contemplates the use of the same air continuously, cleaning and cooling the same, without any possible way for it to mix with impurities from the outside, whereby the problem of cleaning is solved. Further, by the use of the same air subjected always to the same degree of cooling, the device is rendered independent of changes in the temperature of the outside air, the operation being the same in cold, warm, or moist weather. The apparatus herein disclosed avoids the use of cumbersome ventilating air ducts and is made to occupy a relatively small and compact space as compared with the known ventilating devices, thereby effecting great economy of space which is an important consideration in factories, on board vessels, in power plants and the like. Moreover, all high speed electrical machines are more or less noisy when the ventilating air is discharged to atmosphere, but in our closed air system this is reduced to an unobjectionable tone and volume. Also, it is found that the necessary quantity of water for removing generator losses from the heated air is considerably less in our closed circulation system whereby a very appreciable saving in the quantity of water used, as compared with present air systems, of the type where the

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sprayed water is not recirculated is effected.

The water as it is collected after spraying may be removed from the apparatus so that the recirculating air is constantly subjected to the cleaning and cooling action of fresh water. Within the scope and purpose of the invention, however, the sprayed water may be cooled and recirculated to the desired extent.

The air cooled and cleaned as described may be employed for any suitable purpose and in fact the invention is not limited to cooling and cleaning a stream of air as it may be employed in the cooling and cleaning moving bodies of any desired gas. We have however chosen to illustrate the invention as used for cooling and cleannig the ventilating air of an electric generator, the rotor whereof is diagrammatically indicated at 1 in Fig. 1 as rotated by suitable shafting 2.

The stationary parts of the generator, including a substantially air-tight casing are indicated generally at 3 and as indicated by the arrows 3′ in Fig. 1 the air is circulated past or through the parts of the generator but is of use for cooling and cleaning any stream of gas, a blower being provided if, unlike the instance of a generator, such a draft device is not inherently present in a manner that need not be more fully described since while the invention is found to be peculiarly applicable for cooling and cleaning generators, it is not so limited.

The generator or other device or mechanism which is to be subjected to the action of the air is mounted upon a suitable base 4 and beneath said base there is provided a suitable upright passage, chamber or compartment 5 that desirably has metallic side walls and is preferably rectangular in cross section.

In case a closed circulation of the air or other gas is desired, there is arranged a suitable outer casing here shown as comprising upright walls 6, 6 of metal such for example as metal lathing that may if desired be suitably plastered. In said walls suitable emergency dampers are provided such as indicated at 7, 8, 9 in Fig. 1.

The passage, chamber or compartment 5 as shown most clearly in Figs. 2 and 3 has the four walls 10, 11, 12, 13, though any other suitable shape or form may be provided. Within said passage, chamber or compartment and at a suitable height there are provided one, two or more series of spraying devices which in this embodiment of our invention are typified as nozzles 14 of the general type disclosed in the patent to Eneas, No. 1,101,264, dated June 23, 1914. Desirably a plurality of series of spraying nozzles are provided and the arrangement is such that the water can be delivered through one or more series as provided, suitable valves being provided and not herein shown whereby the water may be cut off from any or all of the series.

Referring more particularly to Figs. 2 and 3 there are indicated a lower series of four transversely arranged pipes 15 and a corresponding number of pipes 16 constituting an upper series. Each of said pipes is provided with nozzles 14 in communication with respective pipes through branches 17 and the location of the nozzles is preferably that indicated in Fig. 3 wherefrom it will appear that the nozzles are not directly superposed and the streams therefrom do not interfere.

The water discharged from the nozzles is in the form of very finely divided particles so as to constitute substantially a mist particularly in the upper part 18 of the chamber 5 viewing Figs. 1 and 2. It will be noted that by the arrangement of chambers and nozzles as herein disclosed the warm exhaust air is subjected to the cooling effect of the spray water during the first part of the travel of the air after leaving the generator and before it passes to the return chambers, thus minimizing any tendency of heat absorption by the walls of the chambers.

The water discharged through the various nozzles 14 is discharged therefrom in a wide angle spray that is of substantially uniform homogeneity in transverse section, the water particles being extremely finely divided, and particularly in the upper part 18 of the chamber 5 does the water exist as a fine mist filling the upper part of said chamber but falling therethrough with the descending air. In order, however, to prevent any possibility of the passage of large drops of water to the generator or other mechanism or device to which the cooled and cleansed air passes, we provide any suitable means and herein have represented a series of baffle plates 19 shown most clearly in Fig. 2 as a series of sheet metal plates bent into substantially V form and preferably having edge flanges 20, 20 with perforations permitting them to be strung upon a suitable number of rods 21 or otherwise held in place. These baffle plates are placed sufficiently close together to prevent the passage of large particles of water.

With the apparatus in operation air may be taken from any source outside the walls 6, 6 as for example through the emergency dampers 7, 8 and if desired and within the scope of the invention said walls 6 may be omitted in part. Desirably however, the air is circulated in a closed circuit and as represented in Fig. 1 it passes upward in the direction of the arrows 22 and is then forced by the fan action of the generator rotor through or past the generator or other part that is subjected to the action thereof and then downward in the direction of arrows 23 meeting the ascending water spray and descending with the return thereof. The

air passes downward through the chamber 5 and between and past the various nozzles 14 and then is discharged from the lower part of the chamber 5 in any suitable manner and in any suitable direction. Preferably, however, we provide lateral openings at one or more sides of the chamber 5 and desirably through two opposite walls thereof as clearly indicated in Fig. 2. At said point there are preferably provided eliminator plates which are indicated at 24, 25 in Fig. 2 as plates placed together in parallelism, the plates being preferably of a zigzag shape. These plates may be secured at their edges to the walls of the chamber in any suitable manner as by angle irons and in a manner not necessary more fully to describe. Thus it will be seen that the cooled and cleansed air issues laterally in two or it may be more directions from the lower part of the chamber 5. Desirably the eliminator plates 24, 25 are vertical for compactness of construction and to afford an uninterrupted upward course for the ascending air currents. By thus positioning the eliminator plates vertically, the eliminated moisture is caused to flow vertically down and off from the plates, and does not collect upon the plates in the path of the air flowing to the generator.

While any suitable means may be provided for supplying the water or other liquid to be sprayed the following arrangement has been found in practice to be exceedingly efficient as it effects the constant removal of dirt and foreign matter out of the entire system, so that the recirculated air is constantly washed, and the foreign matter, abstracted from the generator or other part subjected to the action of the air, is constantly removed and does not circulate with the air.

An electric or other motor 26 is provided as shown in Fig. 1 and thereby a pump 27 is driven drawing the water from any suitable outside source through a pipe 28. The water is forced upwardly through the pipe 29 and then laterally through the communicating pipe 30 represented in Fig. 4 where it is received in the upper part 31 of a suitable strainer 32 which effects the separation of the dirt and foreign matter from the incoming water. The water then through suitable couplings indicated at 33, 34, 35 in Fig. 4 enters the pipes 36, 37 which respectively communicate with the pipes 15, 16 extending transversely of the chamber 5 and supporting the spraying nozzles 14. The water from the nozzles 14 rises as stated in a spray or mist through the descending air and then descends through the descending current of air and collects upon the downwardly inclined bottom 38 of the chamber 5; from the lowest part of this bottom extends a drain pipe 39 indicated most clearly in Figs. 2 and 3. The pipe 39 is provided with a T 40 from which extends a pipe 41 that may lead to the drain or final escape of the water, though within the scope and purpose of the invention the water may be cooled and recirculated and particularly in those communities where water is scarce. With the said T 40 also communicates a pipe 42 leading from the lower end of the strainer 32 so that in this manner all the dirt collected either at the strainer 32 or upon the inclined bottom 38 of the chamber 5 passes out of the circulating system.

The chamber 5 may be provided with suitable inspection doors 43 permitting access to the interior of the chamber.

The pipes 15, 16 may be secured in position in any suitable manner. Herein we have represented them as at the left hand side in Figs. 2 and 3 having special pipe caps adapted to abut against the wall 13 and there receive threaded bolts 44, serving to support said pipes at such end. At their opposite end said pipes are supported by the pipes 36, 37 which at their ends are received in the walls 10, 12 of the chamber 5 as shown in Fig. 3.

As hereinbefore set forth, there is a peculiar advantage in spraying the water directly upward as it acts upon the air during the upward progress of the water and again acts thereon during the fall of the sprayed water. It may be desirable to spray the water downward if the air be circulated or travel in an upward direction past such downwardly directed nozzles, but we have found it preferable to pass the air downwardly through the chamber 5 under ordinary conditions.

Particularly is it desirable that the water be sprayed upward into the descending heated air in our closed circulation device, thus securing the maximum cooling and cleaning effect. Since the same air is continuously circulated and recirculated it is essential that it be positively and efficiently cooled, which result is accomplished with great certainty by subjecting the down flowing air to the action of the water sprayed upwardly into said air, and then continuing and prolonging the cooling action of the water by allowing it to turn and descend again in constant and intimate contact with the descending air. It will therefore be apparent that there is a particular cooperation of the upwardly directed nozzles with our closed circulation device wherein the exhaust air travels downwardly, as above set forth.

Having thus disclosed one illustrative embodiment of the apparatus of our invention and having described the best mode known to us for practicing our invention, we desire it to be understood that although specific terms are employed they are used in a

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generic and descriptive sense and not for purposes of limitation, the scope of the invention being set forth in the following claims.

Claims:

1. Air cooling and cleaning apparatus adapted for use with structures to be cooled, comprising in combination a closed circuit for the circulation and recirculation of the air, said circuit including said structure, and means for spraying water or the like directly upwardly into the air in said circuit, whereby the air is directly subjected to the cooling and cleaning effect of said sprayed water and is in such condition circulated past or through said structure.

2. Air cooling and cleaning apparatus comprising, in combination, communicating chambers, means to circulate and recirculate air in a downward and then upward direction therethrough in substantially a closed circuit and nozzles supported to spray liquid upwardly against and into the descending air current to permit the liquid to fall with the descending air current whereby the period of contact of the sprayed liquid with the air current is increased.

3. Air cooling and cleaning apparatus comprising, in combination, a chamber, an outer chamber surrounding the same, and together constituting substantially a closed circuit, means to circulate air upwardly through the outer chamber and downwardly through the inner chamber and nozzles positioned in the inner chamber and upwardly directed to spray water upwardly into the descending air current.

4. Air cooling and cleaning apparatus adapted for use with a superposed body through or past which the air is circulated, comprising in combination, a cooling chamber through which the air is passed vertically downward, an outer chamber surrounding the same to receive the cooled and cleaned air upwardly therethrough, nozzles within said cooling chamber directed upward to spray water upwardly against the descending air current, and one or more passages communicating between said chambers at the lower portions thereof, the whole constituting a substantially closed circuit.

5. The method of conditioning the ventilating air for electrical machinery which consists in passing the exhaust air vertically downward through a chamber, in spraying water vertically upward into the vertically traveling air, and in returning the cooled and cleaned air to the said electrical machine.

6. That method of cooling and cleaning air flowing in a closed circuit comprising passing the warm and unwashed air vertically downward, and spraying a liquid in a substantially vertical stream upwardly into such air and passing said cooled and cleaned air in said closed circuit through or past the apparatus to be cooled.

7. Air cooling and cleaning apparatus adapted for use with superposed structures having fan means for the circulation of the air therethrough, comprising in combination, a closed circuit including a cooling chamber through which the air passes vertically downward and a return chamber communicating therewith and a plurality of upwardly directed spray nozzles supported in said cooling chamber whereby water is sprayed upwardly into the descending air.

8. Apparatus for cooling and cleaning ventilating air and adapted for use in closed communication with structures having air circulating means, comprising in combination, an inner chamber, an outer chamber surrounding the same, upwardly directed nozzles supported within said inner chamber, and communicating passages between said chambers located below said nozzles, whereby the air to be treated passes vertically downward through said inner chamber in contact with liquid from said nozzles both while said liquid is traveling upwardly against the air and while it is descending therewith and thence is returned through said outer chamber for recirculation.

9. In an apparatus for cooling, cleaning and conditioning the ventilating air for use with structures to be cooled, in combination, a warm air receiving chamber through which the air to be cooled, cleaned, and conditioned is passed vertically, spray means in said chamber, a return chamber or chambers, said receiving and return chambers together with said structure constituting a closed circuit for the flow of the air, and passages in the side walls of said warm air receiving chamber to permit the lateral escape of the air to said return chamber or chambers.

In testimony whereof we have signed our names to this specification.

JAMES JARVIS PREBLE.
LEE H. PARKER.