June 15, 1971 A. PETERS 3,584,395

AUTOMOBILE DRYING PLANT

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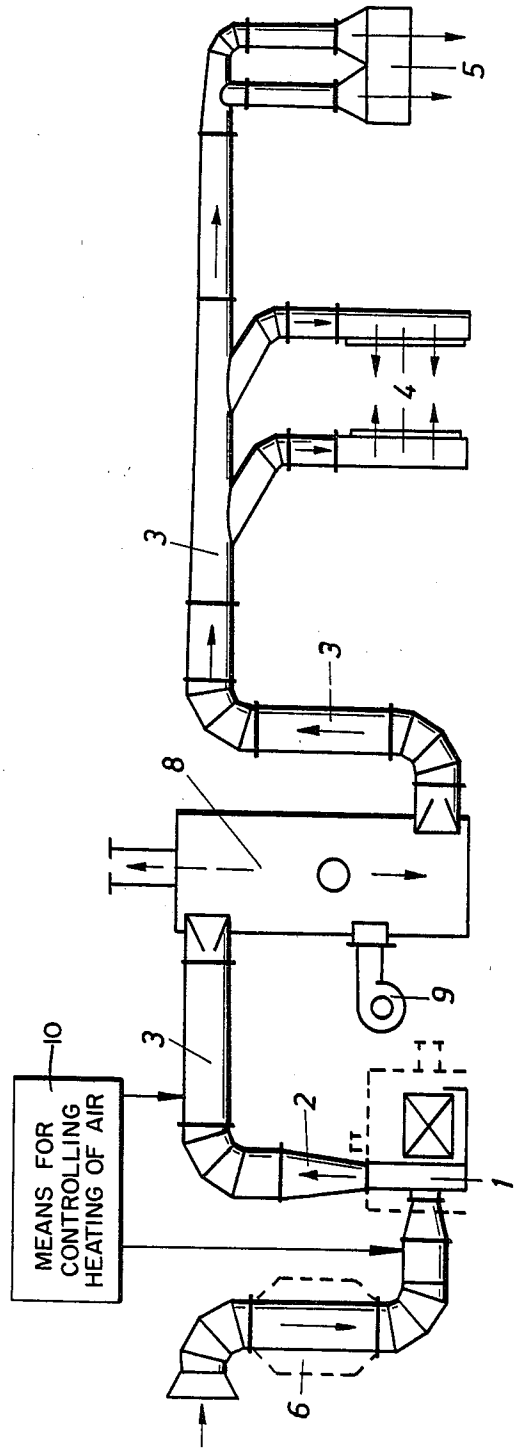


Fig. 1

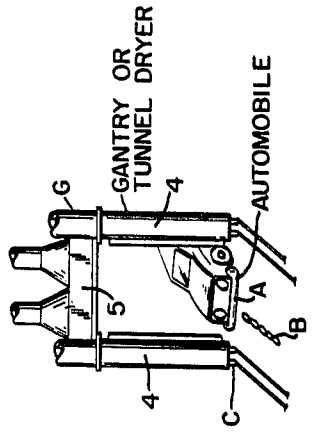


Fig. 1A

ARMIN PETERS
INVENTOR

Karl F. Ross

Attorney

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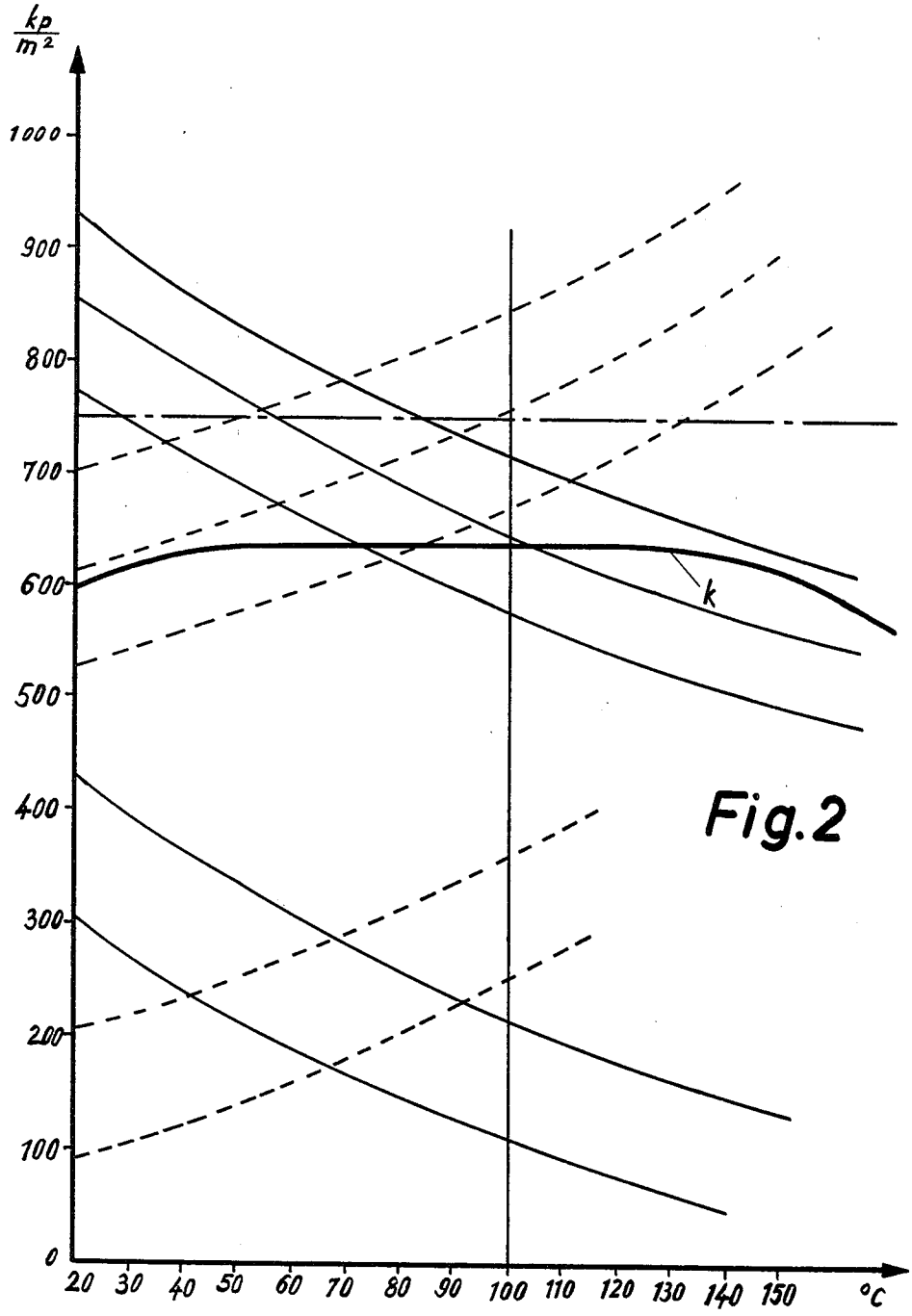


Fig.2

ARNI N PETERS
INVENTOR

Karl F. Ross
Attorney

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AUTOMOBILE DRYING PLANT

Armin Peters, 2 Rosenweg, 452 Melle, Germany

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U.S. Cl. 34—229 3 Claims

ABSTRACT OF THE DISCLOSURE

In order to increase the output capacity and to improve the efficiency of stationary or transportable drying plants for washed vehicles of the type using a tunnel or gantry comprising slot nozzles connected to a high-pressure blower of high efficiency and directing the compressed air with high velocity against the vehicle surfaces to be dried, there is provided heat-exchanging means heated with cheap energy, for instance fuel oil by means of an oil burner, and arranged at the discharge side and, if occasion arises also at the suction side of the blower. By controlling the increase of the air temperature at the pressure side of the blower it is possible to maintain a substantially constant dynamic pressure at the slot nozzles at temperatures varying between 20° C. and 150° C. thereby allowing the drying plant to adapt to the momentarily prevailing output requirements. At the same time the noise level of the blower is reduced substantially by providing the heat exchanging means which acts as sound-damping means. In addition the heat-exchanging means may also include noise-damping means or separate muffling means may be provided in addition to the heat exchanging means.

BACKGROUND OF THE INVENTION

(1) Field of invention

This invention relates to stationary or transportable drying plants used primarily in automobile garages for drying washed cars, wherein air sucked in by a high-pressure blower is directed with high velocity by slot nozzles against the side and top surfaces of the car.

(2) Description of the prior art

In smaller washing garages so-called gantry dryers are used by moving them over the washed vehicle, while in automobile washing lines stationary portal dryers are commonly employed through which the washed vehicles are moved by means of a floor conveyor. The dynamic air pressure generated in these dryers at the slot nozzles due to the great exit velocity is designed to blow off the sprayed water adhering to the vehicle while moving the vehicles past the nozzles with a defined distance, wherein the formation of water drops by water tension may assist this dynamic blow off procedure.

In any case, the vehicle must be wiped-off manually by a person after it has passed the dryer to finally remove traces of drops or small droplets that might still adhere to the vehicles. A characteristic of this type of air-jet drying with cold air is in the fact that the number of persons doing the wiping must increase when the number of vehicles passing the plant increases, and attains a maximum in winter time at low temperature of the garage. In automobile washing lines of any capacity the amount of work varies greatly and depends on the seasons and changes with the weather.

In drying plants of the type the invention is concerned with it has been realized already that it is favorable to increase the temperature of the discharge air directed against the surfaces of the vehicle relative to the temperature of the air sucked into the blower, wherein certain

cooperating reactions on the surface of vigorously moved water drops, or water strands, as well as absorption reactions of the unsaturated masses of air are of great importance. For effectively increasing the discharge temperature initially the procedure was as follows. An increase in temperature is effected by the compression of the air in the high pressure blowers without addition of heat, or emission of heat. This adiabatic increase in temperature is a function of the total pressure difference relative to the environment air and amounts, for example, at an air pressure of 760 torr and a total pressure difference of 800 kp./m.^{2} the temperature increases exactly 6.6°. Additionally a further temperature increase is effected which is a function of the efficiency of the blower. The higher the operating pressure and the poorer the operating efficiency of the blower the higher is the actually achieved increase in temperature between the intake temperature and the discharge temperature. Measurements in existing drying plants showed increases in temperature between 18° and 25° C. with a blower efficiency between 25% and 30%. Thus, during warm summer days when the temperature in the washing garage was about 20° C. the discharge temperature at the nozzles amounted to about 40° C., and satisfactory blow off and drying effects were achieved at an average speed relative of dryer and vehicle. However, the number of dried vehicles remains limited at a constant drying effect unless it is possible to increase the dynamic pressure, or the discharge temperature at the nozzles, or both, when the number of vehicles to be dried is increased.

If, in a colder season, the intake temperatures drop then the actual increase in temperatures achieved in the aforementioned manner do not suffice for an unobjectionable drying procedure, necessitating that for the polishing by hand an increased number of persons must be employed, or the rate of travel of the vehicles must be decreased. In order to avoid the increased employment of persons it has been proposed to install two or even three drying units in series. But even then it was not possible to achieve the same drying effect as in warm seasons when the travelling rate of the vehicles was higher. Also, the installation of a plurality of dryers in series, particularly in washing lines, not only causes an increase in costs of energy but equally in costs of investment and space. In addition to this a noise level of approximately 100 decibels is generated using only one drying unit and when a plurality of drying units is installed in series, the resulting noise level often attains the threshold of pain in the human ear. Attempts to install the high-pressure blower outside of the garage was not entirely successful because even in this case the generated noise level near the drying zone is too high and is insufferable for the worker and for the customer having his vehicle washed.

Due to the extremely poor efficiency of the hitherto used high-pressure blowers, the consumption of electric energy by the drive motors of the blowers is very high, so that the cost of energy of these dryers is extremely high. These energy costs are summing up whenever a plurality of drying units are installed in series, so that often the addition of a transformer station becomes necessary.

Attempts to use the warm air of garage heating units for the drying of vehicles has only brought a limited success since the increase in temperature with simultaneous decrease of the pressure at the nozzles did not suffice, and outside temperatures, directions of wind, and other weather influences vary greatly and cannot be controlled.

Further, it has been attempted in connection with gantry dryers to supply a large volume of air by separate high pressure blowers to each slot nozzle directed against the vehicle surfaces with high jet velocity. In this the intake air was heated at the intake side of the blowers by

heated combustion gases, or by means of heat exchangers, whereby actual increases in temperature up to 40° C. were attained.

But if the intake air at the suction side of the high pressure blower is derived from the heated garage, or the intake air is heated directly or indirectly, the dynamic pressure at the slot nozzles decreases proportionally with the increase in temperature of the intake air, and thus the favorable effect of the increased temperature for the drying process is lost again, or at least lost to a great extent, which means that when the air is heated at the intake side of the blower there is no possibility to control the drying plant and adjust it to the frequently hourly changing vehicle-processing capabilities.

Therefore, in view of the known drying plants the object of this invention is to reduce the operating and investment costs considerably, to make the system independent of weather conditions and temperature conditions in the washing garages, and to employ a minimum number of laborers.

SUMMARY OF THE INVENTION

For solving this problem the invention is characterized substantially in that in the first mentioned drying plant a high-capacity blower driven by an electromotor is combined with heat-exchanging means heated with inexpensive fuel, for example fuel oil, and arranged at the discharge side, or the discharge and suction side of the blower.

The invention avoids the costly electric energy expenditure hitherto common in using high-pressure blowers with high inner resistance, since in using a high-capacity blower with an efficiency up to approximately 90% the consumed energy is nearly completely used for generating the desired dynamic pressure at the nozzles, while the heating of the air at the pressure and the suction side of the blower is achieved by a heat exchanger heated with inexpensive energy.

By means of heating the air at the pressure side of the blower the dynamic pressure increases at the slot nozzles proportionally to the increasing heating temperature, whereby it is possible to control the drying plant in dependence on hourly capacity of passing vehicles and in addition the heat exchanger acts, or may especially be constructed as a muffler.

Particularly favorable working conditions are achieved if the air is heated at the pressure and suction side of the blower, because then it is possible to control the heating of the air upstream and downstream of the blower in such a manner that the dynamic pressure at the slot nozzles remains constant, or nearly constant, at increasing temperature of the delivered air, whereby an adaptation to the hourly changing output capacity of vehicles is possible by controlling the dynamic pressure and/or the temperature.

The subdivision into the source of energy for the high-capacity blower with a high degree of efficiency, and the possibility of heating the air at lower temperature of the intake air at selected temperatures up to approximately 150° C. leads to considerable savings in costs of energy, wages and investments and also in space requirements, while simultaneously damping the blower noise, primarily it is possible to control the dryer in dependence on the desired, or the varying vehicle output.

The invention is further described below in connection with the drawings showing schematically as an example of one embodiment according to the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a schematic layout of the drying plant, in which the air is heated at the pressure side of the blower with or without addition of preheated intake air;

FIG. 1A is a diagrammatic elevation of part of the drying plant;

FIG. 2 is a diagram of the dynamic pressure in dependence on the temperature to which the air has been heated in different arrangements of the heating means for the blower air.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the schematically illustrated embodiment according to FIG. 1 a drying plant for washing vehicles, particularly passenger vehicles is shown constructed in a gantry or tunnel fashion G adjustable to any output of vehicles. The vehicle or the gantry may be displaced as shown B and C to effect relative movement therebetween.

This drying plant comprises only one high capacity blower **1**, driven by an electromotor and a great volume of compressed air is delivered via a diffuser **2** and ducts to slot nozzles **4** directing the air at high velocity towards the side surfaces and to slot nozzle **5** directing the air at high velocity toward the top surface of the vehicle. But, according to the invention, it is also possible to provide a plurality of separate high capacity blowers for the nozzles. At the suction side of the blower a muffler **6** shown in dotted lines is provided for damping the noise of the blower, and a heat exchanger **8** is mounted in the pressure side within which the compressed air is heated, particularly by an oil burner **9**, or a natural gas burner, or the like, with inexpensive energy, which burner is adapted to the capacity of the blower and the desired temperature increase of the compressed air at the nozzles, and which advantageously operates automatically.

This drying plant operates at an extremely low noise level since, on the one hand, a muffler **6** is provided at the suction side and since, on the other hand, the heat exchanger **8** at the pressure side acts as a muffler, or may especially be constructed as a muffler, or may be combined with a muffler whereby the plant may be connected directly to the gantry or tunnel.

For a better understanding of the invention first the curves of the dynamic pressure at the slot nozzles in dependence on the temperature to which the blower air is heated are considered in FIG. 2.

If the air is heated at the suction side of the blower in a known manner the dynamic pressure drops at the nozzles with increasing temperatures, as shown in solid lines. An improvement of the drying process of the vehicles with increased temperatures is correspondingly cancelled totally, or at least to the greatest part, by the decreasing dynamic pressure, and consequently this heating of the air at the suction side of the blower does not allow a control to adapt the plant to the hourly varying output of vehicles.

If, contrary to this, the air is heated by a heat exchanger at the pressure side of the blower, in accordance with the invention, the dynamic pressure at the slot nozzles rises proportionally to the increasing temperatures, as illustrated in the curves shown in dotted lines, and thus it is possible to control the drying effect and adapt the plant to the hourly vehicle output within certain limits and in dependence from the initial value of the dynamic pressure at room temperature.

Out of the dropping curves of the dynamic pressure when heating the air at the suction side of the blower and the rising curves when heating the air at the pressure side of the blower it will become evident that, if both types of heating are employed the conditions may be chosen in such a manner that always a dropping and a rising curve may be superimposed, so that the resulting dynamic pressure remains constant, or nearly constant, over a temperature range between 20° C. and approximately 150° C., as, for example, illustrated by the line *k* in FIG. 2. Thus, it is possible, by simply controlling the air temperature at both sides of the blower, to adapt the plant to an hourly changing vehicle output which may increase from a minimum to a maximum, and this, which is important, independently of dropping tempera-

tures in the washing room since the temperature of the air discharged out of the slot nozzles may be increased up to a maximum of 150° C.

Corresponding to this extremely favorable solution one can proceed according to FIG. 1 in such a way that the heat exchanger **8** is installed in the pressure side of the blower, and that heated air, for example circulated air, is supplied to the suction side, wherein also a heat exchanger may be installed in the suction side. In case of the first embodiment it is advantageous for dampening the noise to install the muffler **6** in the suction side, but it is also possible to install a similar muffler additionally in the pressure side if the heat exchanger **8** for itself should not suffice to dampen the noise. These arrangements are shown by the means **10** for controlling heating of the air upstream and downstream of the blower **1**. This means **10** can include a second heat exchanger, similar to the exchanger **8**, or the like, for supplying preheated air to the blower at a rate such that the dynamic pressure at the nozzles **4** and **5** remains substantially constant at temperatures of the discharged air between 20° C. and 150° C. It can further include a muffler, like muffler **6**, downstream of the blower.

What is claimed:

1. A drying plant for washed vehicles comprising in combination:

(a) a structure adapted to embrace the top and the sides of the washed vehicle;

(b) means effecting a relative movement between said structure and said vehicle;

(c) at least one high-pressure air blower of high efficiency driven by an electric motor and having a suction side and a pressure side;

(d) lateral and upper slot nozzles on said structure and ducts connecting said nozzles to the pressure side of said blower for directing the discharged air with high velocity at a substantially constant dynamic pressure against the side and top surfaces of said vehicle;

(e) at least one heat exchanger arranged between the pressure side of said blower and said slot nozzles and fueled heating means at said heat exchanger for heating the air traversing same; and

(f) means for supplying preheated air to the suction side of said blower at a rate such that the dynamic pressure at said nozzles remains substantially constant at increasing temperatures of the discharged air between 20° C. and 150° C.

2. A drying plant for washed vehicle comprising in combination:

(a) a structure adapted to embrace the top and the sides of the washed vehicle;

(b) means effecting a relative movement between said structure and said vehicle;

(c) at least one high-pressure blower of high efficiency driven by an electric motor and having a suction side and a pressure side;

(d) lateral and upper slot nozzles and ducts connecting said nozzles to the pressure side of said blower for directing the discharged air with high velocity at a substantially constant dynamic pressure against the side and top surfaces of said vehicle;

(e) at least one heat exchanger arranged between the outlet of said blower and said slot nozzles and oil-fueled heating means in said heat exchanger for heating the air traversing same; and

(f) a second heat exchanger arranged at the suction side of said blower supplying preheated air to the blower at a volume rate such that the dynamic pressure at said nozzles remains substantially constant at increasing temperatures of the discharged air between 20° C. and 150° C.

3. A drying plant according to claim **2** further comprising sound-muffling means at the suction and pressure sides of said blower.

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FREDERICK L. MATTESON, JR., Primary Examiner

H. B. RAMEY, Assistant Examiner