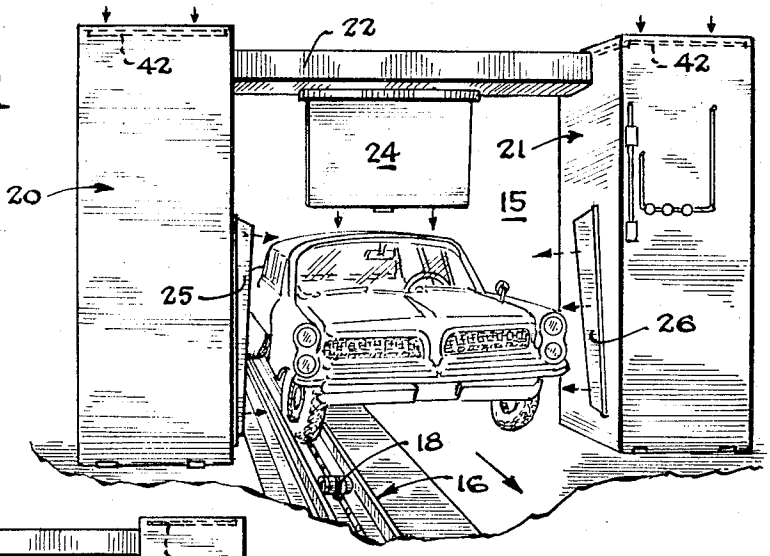
Feb. 6, 1968 J. VANI 3,367,040

AUTOMOBILE DRIER UNIT WITH MUFFLER MEANS AND SELECTIVELY OPERABLE AIR DIVERTING MEANS

Filed June 5, 1964 4 Sheets-Sheet 1

Fig.1



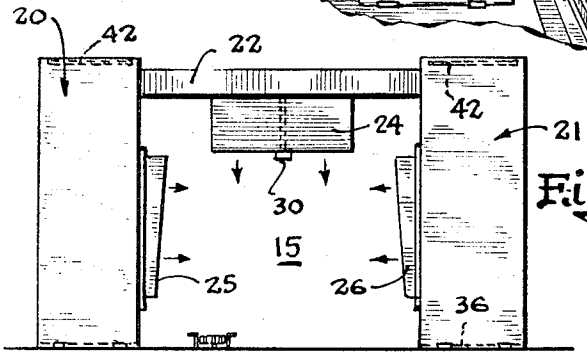
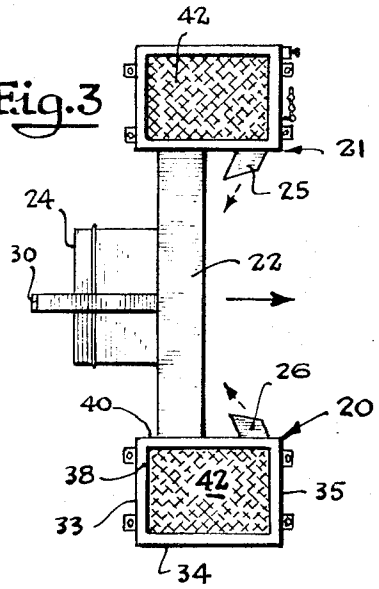


Fig.2

Fig.3



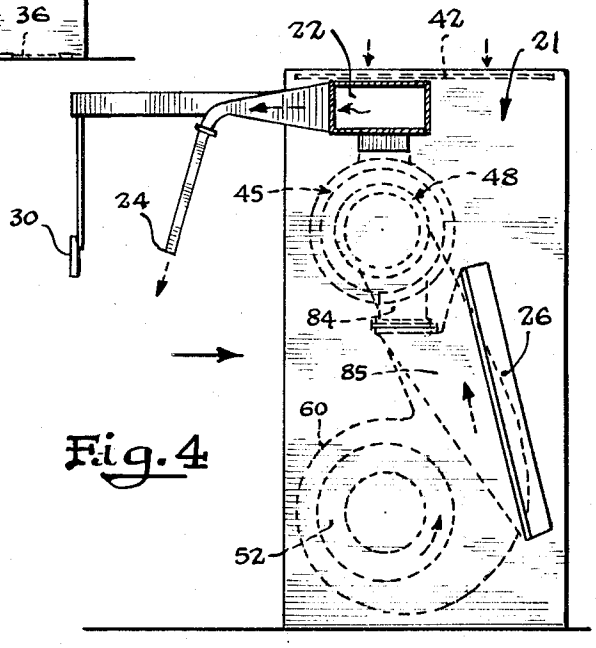


Fig.4

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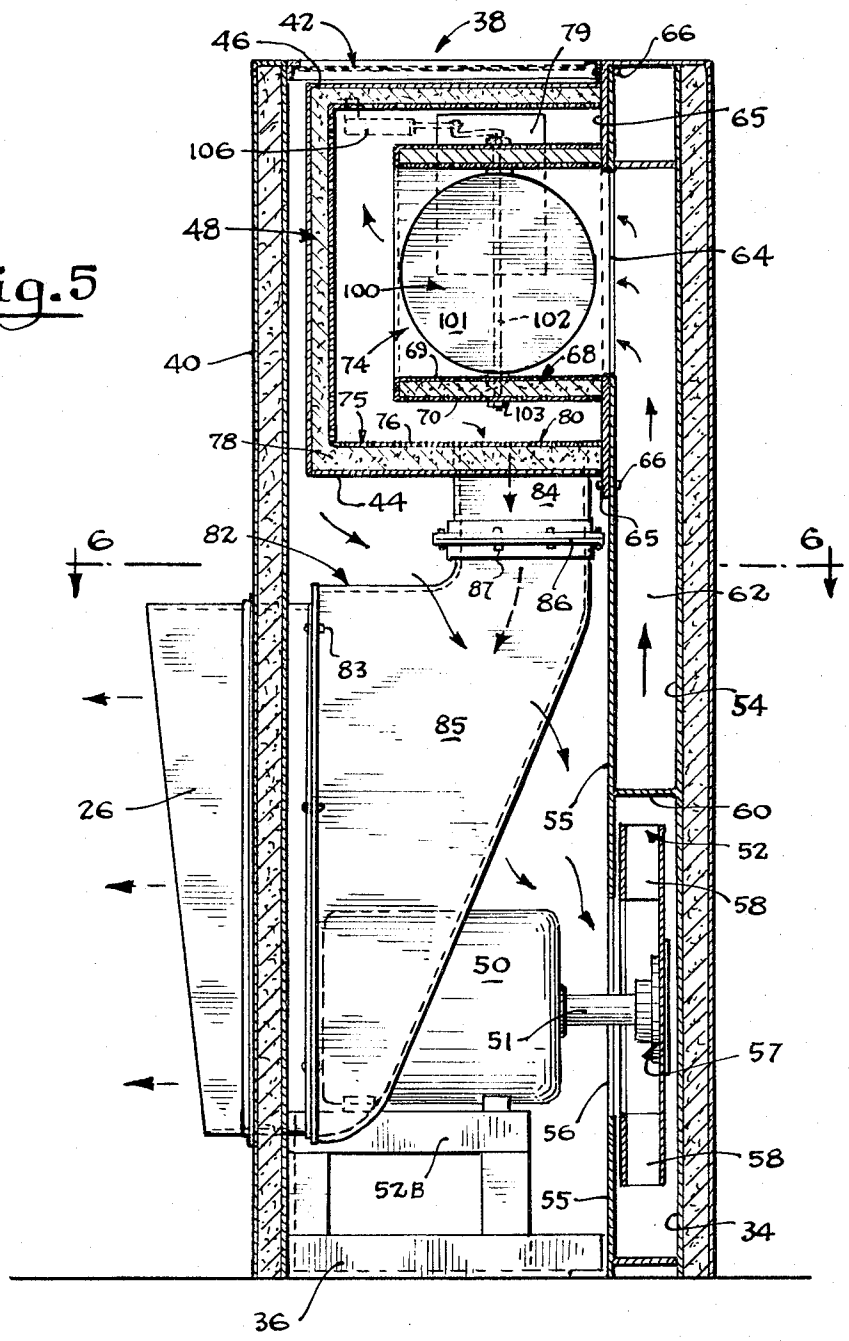
Fig. 5



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AUTOMOBILE DRIER UNIT WITH MUFFLER MEANS AND SELECTIVELY OPERABLE AIR DIVERTING MEANS

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Fig. 6

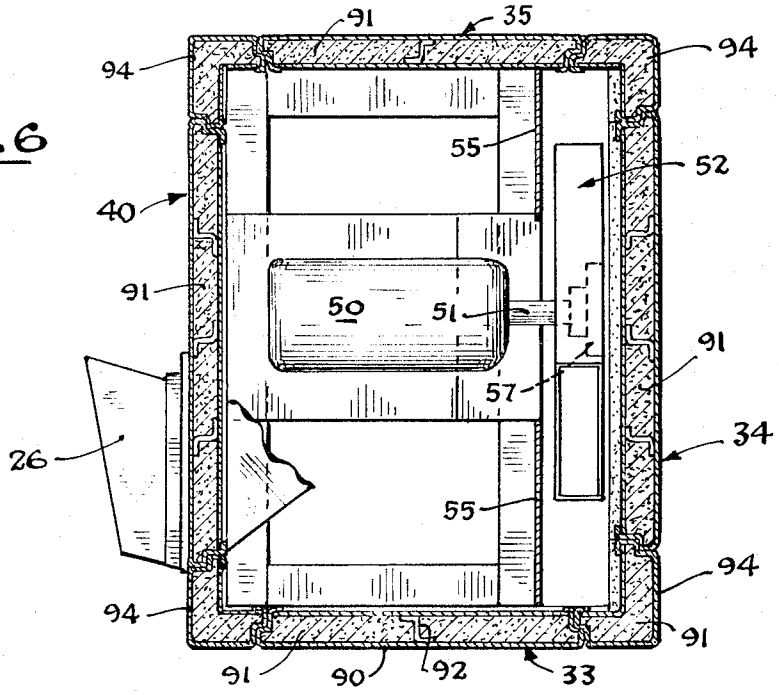

Fig. 7

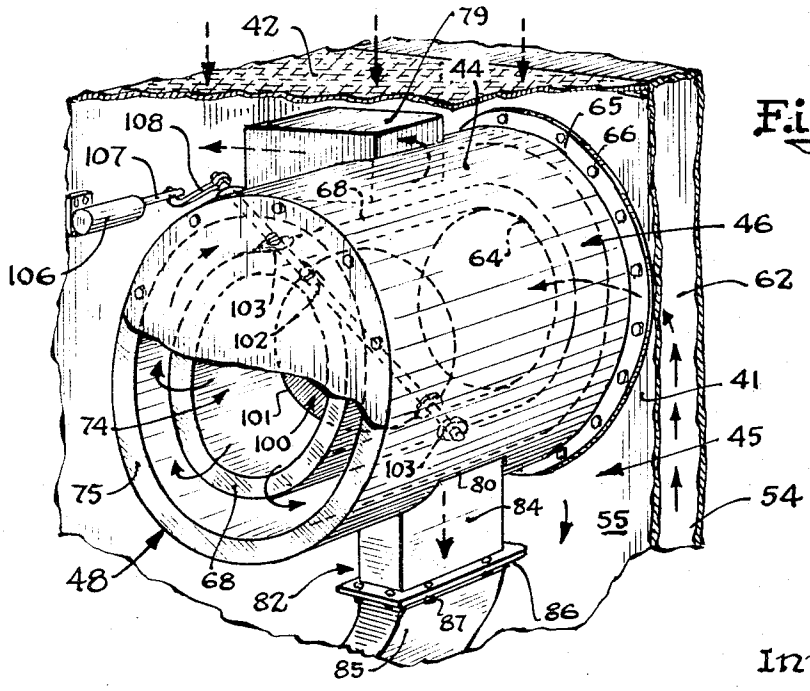

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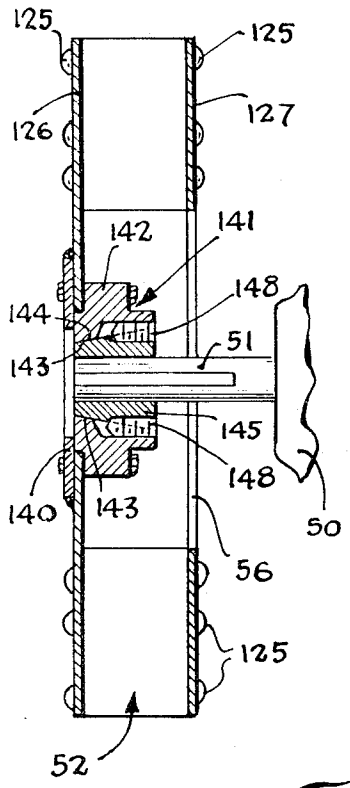
Fig. 8



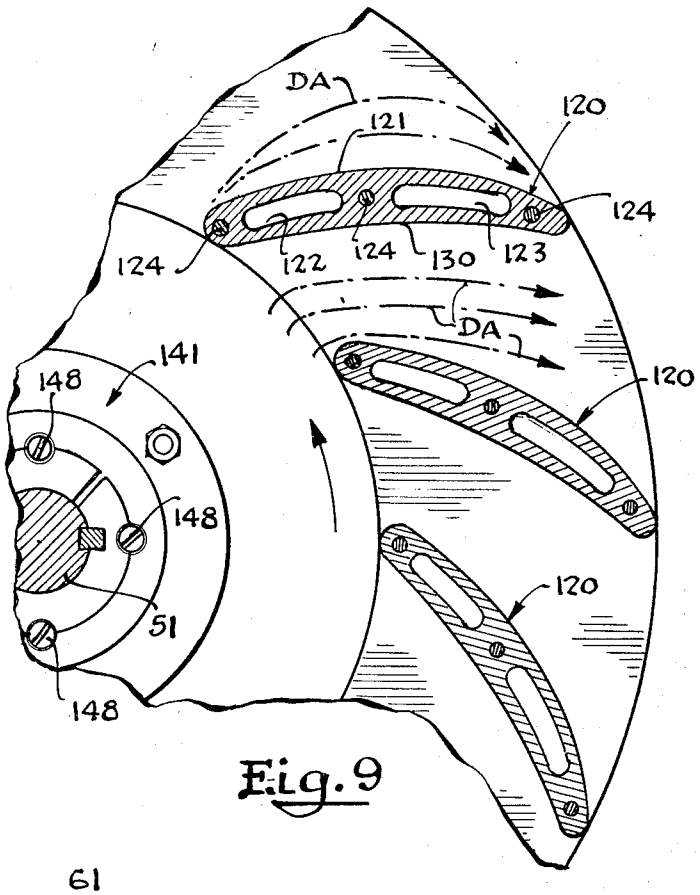


Fig. 9

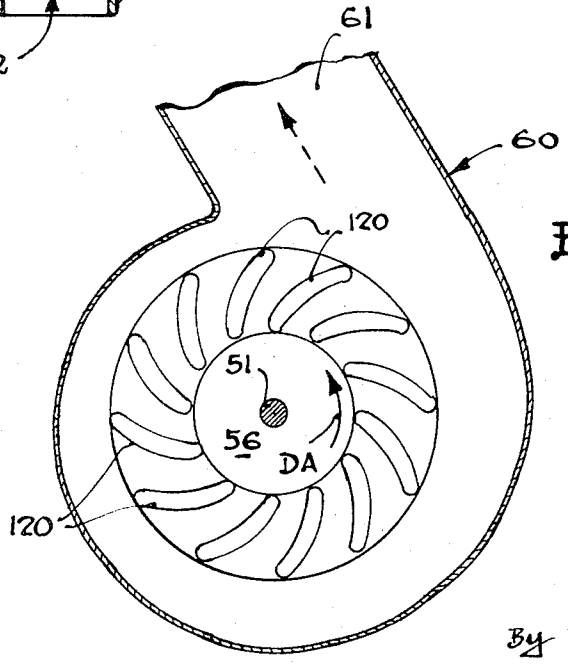


Fig. 10

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United States Patent Office

3,367,040

Patented Feb. 6, 1968

3,367,040

AUTOMOBILE DRIER UNIT WITH MUFFLER MEANS AND SELECTIVELY OPERABLE AIR DIVERTING MEANS

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Filed June 5, 1964, Ser. No. 372,879
4 Claims. (Cl. 34—54)

This invention relates to car washing apparatus and in particular to the construction and arrangement of dryers adapted to dry by sweeping residual water from a rinsed car by forced air emitted from nozzles directed toward the sides and top of the car.

In a standard form of automated car washing equipment, the vehicle to be washed is moved sequentially through a plurality of stations including an initial vacuuming and steam cleaning station, a scrubbing station, a rinsing station and finally a drying station at which dryers are effective to remove almost entirely remaining films of rinsing water. The drying operation is most frequently performed by nozzles through which air is forced from impeller units.

In the interest of accelerating the drying operations, particularly on busy days when there is a heavy stream of traffic through the washing equipment, heavy-duty electrically powered motors drive the impeller units to deliver large quantities of air at high velocity. This, of course, entails significant power requirements and also expensive motor units, and the primary object of the present invention is to increase the blower efficiency thereby reducing power requirements. Specifically, this object of the invention is achieved by constructing the impeller blades to present air foil geometry at the working surface of the impellers, and it is found that the efficiency of air emitted through the dryer nozzles is increased as much as 30%, making possible a utilization of lower power requirements for driving the impellers.

As noted above, a significant factor entering into the design of equipment to which the present invention relates is the density of traffic through the washing apparatus. On busy days it is important to accelerate drying so that an automobile or other vehicle stands in the drying station for as short a time as possible. On the other hand, and in view of the expensive and heavy-duty power equipment required, it is desirable to be able to save on the expense, reducing overhead, and this possibility is presented in those instances where the traffic through the washing apparatus is not so heavy, that is, the number of vehicles on a particular day is sparse. Therefore, another object of the present invention is to enable the dryer apparatus to be varied for heavy or sparse traffic, thereby relating the rate of traffic to overhead or expense of operation. Another object of the invention is to provide blower units on both sides of a vehicle and relate the blower units so that with heavy traffic each blower unit supplies air for drying one side of a vehicle and with light traffic one blower unit can supply air for drying both sides of a vehicle. Specifically, this object of the invention is accomplished or satisfied by incorporating in the dryer equipment an interrelated set of dampers such that with both dampers open, the drying apparatus is accommodated to heavy traffic through the washing equipment, whereas with one of the dampers closed, the dryer apparatus is accommodated to a lower rate of traffic. Furthermore, this arrangement of dampers enables one of the blower units to be idle, and therefore conserved while the other blower unit is operating, and by switching back and forth no one blower unit is overly taxed.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which,

by way of illustration, show preferred embodiments of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention.

In the drawings:

FIG. 1 is a perspective view of a car at a drying station in an automatic car wash line;

FIG. 2 is a front elevational view of the drying station;

FIG. 3 is a plan view of the drying station;

FIG. 4 is a side view of the drying station;

FIG. 5 is an enlarged sectional view of one side of a drying station;

FIG. 6 is a sectional view taken along the lines 6—6 of FIG. 5;

FIG. 7 is a perspective view of a muffler and attached ducts;

FIG. 8 is a view of an impeller for the air blower unit;

FIG. 9 is a sectional view of the impeller blades; and

FIG. 10 is a view of the impeller scroll or housing.

Referring now to the drawings, and in first instance to the perspective view of FIG. 1, there is illustrated an automobile at a drying station **15** of an automatic car wash line through which the vehicle has been pulled by a conveyor **16** having rollers **18**, one being behind the wheel of the car. The typical automatic car wash line has an initial vacuuming station wherein the interior of the vehicle is vacuumed; a steam and water cleaning station wherein the car is wetted and a soap or detergent is applied; a scrubbing station wherein the car is scrubbed by brushes or the like; a rinsing station wherein water is swept across the car to remove the detergent and any remaining dirt; and finally the drying station **15** at which high velocity streams of air are directed along the sides of the vehicle and across the top of the vehicle to sweep the rinse water rearwardly and downwardly from the vehicle. The velocity of the air leaving the nozzles in the present invention is in excess of 250 m.p.h. and the air is thus directed by the nozzles to sweep the water from the car as the car is pulled through the stationary drying station, and additionally, the air evaporates some of the moisture from the car body.

As seen in FIGS. 1 and 2, the drying station **15** is generally a U-shaped structure with a pair of side units or towers **20** and **21** between which extends an overhead duct **22**, which applies air to an overhead or top nozzle means **24**. The side units **20** and **21** each have a side nozzle **25** and **26** each of which is adapted to extend generally transverse the side of the car body so as to apply air across the entire sides of the vehicle body. As seen in FIGS. 2 and 3, the top nozzle **24** is adapted to extend across the hood of the vehicle to applying drying air thereto, and as the windshield of the vehicle contacts a trip switch **30** disposed forwardly of the top nozzle **24**, the top nozzle swings upwardly to clear the windshield and the roof of the vehicle so as to be in position to sweep air across the roof of the vehicle without contacting the windshield or roof.

The side units **20** and **21** are identical in construction and are each adapted to supply air at high velocity to the top duct **22** for the top nozzle **24**. In the description hereinafter, only one of the side units, namely side unit **21**, is described, and the description is applicable to the other side unit **20**.

The side unit **21** has three closed and vertically extending outer side walls **33**, **34** and **35** which extend upward from a base **36** to an open top plate **38**. The side walls **33**, **34** and **35** are joined to each other at a bottom or base

36 and to a fourth side wall 40, in which is disposed the side nozzle 26 to provide a genererally soundproof and airtight enclosure or housing. Air enters a side unit 21 or 22 through a screened filter 42 disposed in the opening in the top plate 38.

Disposed interiorly of the housing 41, is the muffler and duct unit 45, FIG. 7. The inlet air entering the filter 42 at the top of the unit 21 or 22 passes about a curved outer wall 44 of the muffler 48 and downwardly towards a motor 50 having a shaft 51 for driving an impeller 52, FIG. 5. The motor 50 is suitably secured on a mounting block 52B fastened to the base 36. Extending upwardly from the base 36 is an interior duct wall 55 which extends between the opposite side walls 33 and 35 and is spaced from an outer duct wall 54. An annular opening 56 is formed in the wall 55 opposite the motor 50 and adjacent the inner or hub portion 57 of the impeller 52 so as to permit the inlet air to be drawn into the center and interior of the impeller 52 wherein the air is driven by the impeller blades 58 within the confines of the impeller housing or scroll 60, as best seen in FIG. 10. The inlet air now at high velocity exits at opening 61 into a duct space 62 formed between the inner duct wall 55 and the outer duct wall 54. The impeller 52 drives the air upwardly through the duct 62 and into an annular opening 64 in a duct wall 55 and through an inner ring 68 of a pair of concentric rings of the muffler 48. The muffler and duct unit 45 has an annular attaching flange 65, which is secured by suitable nut and bolt fasteners 66 to the duct wall 55, so that the opening in the inner ring 68 of the muffler 48 is aligned with the opening 64 in the wall 55.

The inner muffler ring 68 is in the form of a cylindrical element having a pair of inner and outer screen or expanded metal members 69 and 70 between which is inserted a filler of fibre glass insulation or the like. The high velocity air entering the inner ring 68 of the muffler 48 exits its open and outer end 74 and is confined within an encircling outer cylindrical member or cylinder 75, which is also secured to the attaching flange 65. The outer muffler cylinder 75 has an inner screen or expanded metal member 76 and has the outer solid or sheet metal wall 44 about which the low velocity inlet air flows to the impeller 52. Between the cylindrical walls 76 and 44, there is disposed a layer of insulation such as fibre glass or the like. Thus, the air entering the muffler 48 at the opening 64 flows generally through the inner opening in the inner cylinder member 68 and exits the opening 74 and flows rearwardly in the annular space between the concentric rings 68 and 75. The air leaves this annular air space through top duct opening 79 and side duct opening 80.

As best seen in FIG. 7, the muffler 48 has a side duct 82 extending generally downwardly and toward the nozzle 26, to which the side duct 82 is connected by a series of fasteners 83. The side duct 82 is composed of a two-part construction having a first part 84 connected to the outer cylinder member 75, as by welding or the like, and a lower portion 85 generally tapered and flared in construction at the portion attached by the bolts 83. The portions 84 and 85 of the duct 82 are connected by attaching flanges 86 in which are disposed suitable nut and bolts 87.

Since the air exiting the nozzles 24, 25 and 26 is in excess of 250 m.p.h. and in some applications has a velocity of 300 m.p.h., the muffler 48 is adapted to dampen or choke out much of the noise or vibrations attendant with the generation and the conveying of high velocity air through a duct system.

The vertically extending side walls 33, 34, 35 and 40 include exterior panel members 90, FIG. 6, having three inches of insulation 91 disposed between Z section reinforcing elements 92. The panels 90 are joined at the respective four corners by corner panels 94 which are likewise filled with three inches of insulation to reduce the possibility of noise transmission through and across the wide side walls of a housing unit 20 and 21.

Summarizing the operation hereinbefore described, it will be seen that air enters through the filters 42 at the top of each of the respective side units 20 and 21, and flows downwardly about the sides of the outer cylindrical sheet metal surface 44 of the muffler 48, and flows downwardly past the side duct 82 to the opening 56 in the duct wall 55 to the center portion of the impeller 52 and impeller housing 60, whereupon the impeller 52 forces the air about the scroll 60 to exit the scroll opening 61 at a high velocity. The high velocity air moves upwardly through the duct 62 and into the opening 64 of the inner cylindrical member 68 of the muffler 48, exits the end 74 of the inner muffler member 68 to flow rearwardly in the annular air space between the inner muffler member 68 and the outer muffler element 75 to an upper duct opening 79 and a side wall duct opening 80. The high velocity air flows through the respective side nozzle ducts 85 to the respective side nozzles 25 and 26 wherein the air is directed against the sides of the automobile moving therethrough. High velocity air from each of the respective side units 20 and 21 flow through the duct units toward each other and toward the top nozzle 24 wherein the converging streams of air are directed downwardly through the top nozzle 24 to sweep across the top of the vehicle.

With the present invention, each of the motors 50 for the side units 20 and 21 is preferably a 50 horsepower motor and as can be readily appreciated the power requirements for operation of both motors simultaneously is quite considerable. It is an important aspect of the present invention that on days where the traffic moving through the car wash line 15 and through the drying station, is relatively light, as compared to the traffic capable of being moved through the car wash system and the drying station in heavy traffic days. At times of light traffic, one of the motors 50 can be shut off and high velocity air generated by one of the blower units can be ducted to both side nozzles 25 and 26, as well as the top nozzle 24. For this purpose, each of the side units 20 and 21 is provided with a novel damper means 100, which permits the blocking of the air intake for its respective side unit 20 or 21 to thereby assure that the high velocity air generated by the other unit cannot escape through the air inlet and that the high velocity air is diverted to its respective side nozzle and to the side of the car opposite the blower unit generating the high pressure air.

The damper means 100 has a circular damper plate or flap 101 which is secured to a bar 102, the bar 102 being journaled in flange bearings 103 secured on the metal housing of the muffler 48. The circular plate 101 is normally positioned in a non-blocking position within the bore of the small cylindrical muffler 68 element and presents only a thin leading edge to the air entering the muffler when in its non-blocking position. However, the damper means 100 is adapted to be moved to a blocking position wherein the circular plate 101 is rotated through 90° to a position wherein the entire circular area of the plate 101 is disposed across the bore of the cylindrical member 68 to block movement of air entering into the muffler 48 from flowing into the duct 62.

The damper rod 102 is rotated by actuation of an air cylinder 106 which forces its plunger 107 outwardly of the cylinder 106 to rotate a crank 108 attached to the rod 102. The air cylinder 106 is a double acting air cylinder so that when air pressure is reversed, the piston rod 107 is moved inwardly into the cylinder 106 and causes the crank 108 to rotate the damper flap 101 to the closed position.

It will be realized that at periods of heavy traffic that both of the damper flaps 101 will be open and that both blower units will be supplying air to the top nozzle 24 and to their respective side nozzles 25 and 26. However,

at periods of slower traffic, a switch will be thrown to actuate one of the air cylinders **106** to pull its piston rod **107** inwardly to rotate the rod **102** and damper flap **101** through the crank **108**. For instance, the damper flap **101** would be pivoted to its blocking position within the side unit **21**, and the damper flap **101** for the side unit **20** would be in its unblocking position. With the damper flap **101** for the unit **20** in its unblocked position, the blower unit for the side unit **20** is forcing air across the upper duct **22** to enter through the opening **79** into the muffler **48** of the side unit **21**. Because of the blocking position of the damper **101**, the high velocity air entering the muffler unit **48** through the top duct **22** and its opening **79** flows in the annular air space about the inner cylindrical muffler member **68** and out opening **80** in outer muffler member **75** and through the side duct **82** to the side nozzle **26** for the side unit **21**. Thus, it will be seen that the side unit **20** is capable of providing air not only to the top nozzle **24**, but to both of the side nozzles **25** and **26**. If it were not for the damper flap **101**, the forced air entering the muffler **48** from the top duct **22** would flow through the bore of the inner muffler **68** and through the duct **62**, and in turn through the impeller and then outwardly the air intake **42** to atmosphere. Hence, the closing of a damper flap **101** prevents the exhausting of high velocity air from one of the side units through the air inlet of its opposite side unit and diverts high velocity air through the muffler and opposite side nozzle of its opposite side unit to the side of car opposite its own muffler and side nozzle.

It will be appreciated that the ability to employ only one of two electric motors of a range of 30 to 80 HP can result in a significant savings in the amount of power required and thereby reduce operating expenses considerably. Also, the preesnt invention is adapated to reduce the power requirements for a blower unit to produce the 250 m.p.h. or more air velocity, 20 ounces of static pressure, and 16,600 c.f.m. at an air drying station for a car wash line.

More specifically, the conventional dryer units have employed 120 to 140 HP to produce air at the rate of 1,660 c.f.m. at 250 m.p.h. By an improved impeller design, the present invention has been found to reduce horsepower of the impeller motors by about 30% for an installation corresponding in size to a prior art installation. In the present invention, as best seen in FIG. 9, the cross section of the impeller blades **120** is changed from that of the normal flat blade heretofore employed to a blade having an air foil working surface **121**. Preferably, the blades **120** are hollow aluminum blades with central cavities **122** and **123** therein to reduce the weight. Three tapped openings **124** are formed in the ends of each blade **120** to receive screw type fasteners **125** which secure the opposite ends of the respective blades **120** to impeller side plates **126** and **127**, respectively.

The air foil surface **121** has a greater curvature than the bottom surface **130** of the same blade, the bottom surface **130** being practically flat or having a slight curvature thereto. The general path of air flow from the center of the impeller as shown in FIG. 9 as being free from the central portion outwardly along the air foil surface **121** and between the rear surface of the preceding blade in the direction of rotation DA, FIG. 9. In accordance with well-known theory, the stream of air moving across an air foil surface **121** is forced to flow through a constricted area and its speed is increased while the air at a higher level above the air foil surface is not so constricted. An area of less pressure is formed above the blade **120** than below the blade **120** giving the typical lift as in airplane wing air foil surface. The air foil surface reduces air turbulence at the outer ends of the impeller blades **120**. The relative efficiency of the impeller employing blades **120** having an air foil surface **121** is markedly pronounced and has been found to be increased by the surprising amount of approximately 30% in some applications.

As seen in FIG. 8, the driving shaft for the motor has secured thereto a circular plate **140** to which is secured an inclined plane coupling **141**. The inclined plane coupling **141** has an outer flange **142** with an inner inclined surface **143** adapted to be in mating engagement with an inclined surface **144** of an inner bushing **145**. The flange **142** and bushing **145** each are half threaded with mating threads at selected spaces on the inclined surfaces **143** and **144** to receive threaded screws **148**. The screws **148**, upon being turned in one direction in the threads force the bushing **145** leftwardly as viewed in FIG. 9, to be clamped more tightly to the motor shaft. While not shown, it is to be understood that the bushing **145** has a slit extending axially through its body so that the bushing can be forced to have a smaller inner diameter as its surface **143** is forced leftwardly along the inclined surface **144** by the screw **148**.

From the foregoing, it will be seen that the present invention is particularly adapted to reduce the power requirements for an air drying station by increasing the blower efficiency by employing impeller blades in the blower, having an air foil working surface to drive the air.

Also, it is noted that the present invention provides the reduction of expense by affording a drying system adapted to be varied for heavy duty or light duty traffic by selectively enabling a blower unit to supply air to either one side nozzle or to both side nozzles, as well as to a top nozzle. More specifically, the present invention employs damper means to permit the flow of air from one blower unit across a top duct and into the side nozzle, at the opposite side of the automobile, while a damper means is blocking the exist of the high velocity air out the air intake for the idle blower unit.

Hence, while preferred embodiments of the invention have been described and illustrated, it is to be understood that they are capable of variation and modification.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Dryer apparatus for installation in an automobile car washing unit to sweep air across each side of a vehicle and across the top of a vehicle moving through said washing unit, said dryer apparatus comprising a first blower unit disposed on one side of the path of movement of the vehicle and adapted to produce a stream of air under pressure through a first outlet in fluid communication with the first blower unit for drying the vehicle, a first side nozzle means in fluid communication with and receiving air from the outlet of said first blower unit to apply air to the first side of the vehicle, a second blower unit disposed on the other side of said path of movement of said vehicle and adapted to produce air under pressure through a second outlet in fluid communication therewith for drying said vehicle, a second side nozzle means in fluid communication with the outlet of said second blower unit and adapted to apply air to the other side of said vehicle, a duct means extending above the path of movement of said vehicle and in fluid communication with the outlet of each blower unit, a top nozzle means in said duct means adapted to receive air from the outlet of each of said first and second blower units to sweep air across the top of a vehicle, means for operating the blower units in unison at times of heavy traffic and for disabling one of the blower units at times of light traffic, and selectively operable control means for diverting air from the operative one of said blower units through the outlet of the opposite blower unit and the corresponding side and top nozzle means associated therewith when said opposite blower unit is disabled for periods of light traffic, said selectively operable control means including damper means for blocking a por-

tion of the outlet leading to communication with the disabled blower unit.

2. Dryer apparatus for installation in an automobile vehicle car washing unit to sweep air across offset sides of a car and across the top of a car along a path moving through said car washing unit, said dryer apparatus comprising a first blower unit disposed on one side of the vehicle path and adapted to produce a stream of air under pressure for drying the automobile, a first muffler means connected to said first blower unit to dampen the noise of its air stream, a first side nozzle means receiving air from said first muffler means to apply to one side of an automobile, a second blower unit disposed on the other side of said path of movement of said vehicle adapted to produce a stream of air under pressure for drying the other side of said vehicle, a second muffler means connected to said second blower unit to dampen the noise of its air stream, a second side nozzle means in fluid communication with said second muffler means and adapted to sweep air across the other side of said vehicle, a duct means extending across the path of movement of said vehicle and connected to said first and second muffler means, a top nozzle means in said duct means adapted to receive air from said first and second muffler means to sweep air across the top of a vehicle, and selectively operable control means for diverting air from one of said blower units through its opposite blower unit, and corresponding nozzle means when said opposite blower unit is disabled for periods of light traffic.

3. The dryer apparatus of claim 2 wherein said control means includes a damper means disposed in each of said muffler means, each of said damper means being selectively positionable to block flow of air from said duct means to its connected blower unit and to divert the flow of air to its connected side nozzle means so that a blower unit can supply air under pressure to the other side nozzle means without exhausting air through the opposite, disabled blower unit.

4. The dryer apparatus of claim 3 wherein said first and second muffler means include spaced inner and outer cylinder means of different diameters and different lengths, each of said inner cylinder means being connected to its respective air blower unit, each of said outer cylinder means being connected to its respective side nozzle means and also connected to said top nozzle means, each of said damper means disposed in its associated inner cylinder means to block flow of air entering from said duct means to its associated blower unit when its associated blower unit is disabled.

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