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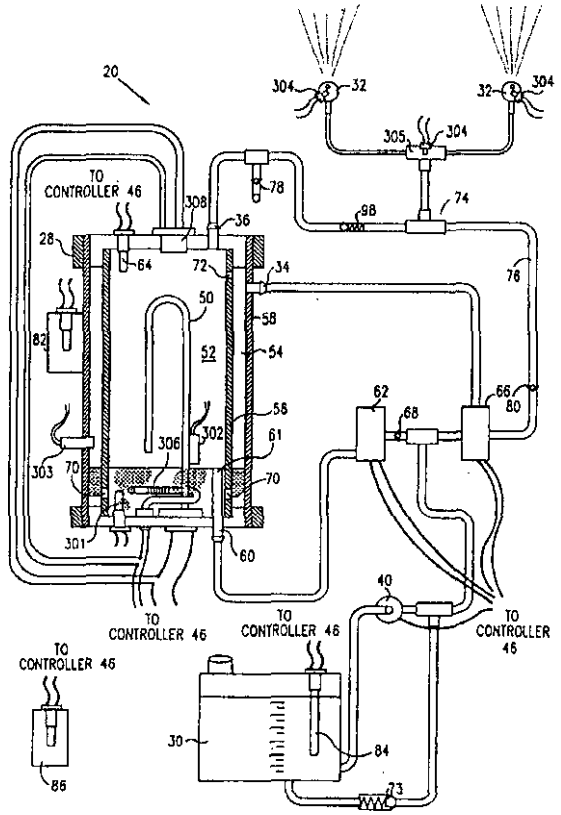
(54) Title: APPARATUS FOR CLEANING OR DE-ICING A VEHICLE WINDOW

(57) Abstract

Apparatus (20) for cleaning or de-icing a vehicle window (24) including a reservoir (30) for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet (36) through which the fluid is discharged for cleaning a vehicle window, and a first heating element (50) disposed in the vessel for heating the fluid in the vessel, characterized by an auxiliary heating element (306) being disposed in the vessel for heating the fluid in the vessel, wherein the auxiliary heating element is disposed at a bottom portion of the vessel and is operative to heat a quantity of fluid which is not necessarily sufficient to cover the first heating element.



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APPARATUS FOR CLEANING OR DE-ICING A VEHICLE WINDOW

FIELD OF THE INVENTION

The present invention relates generally to apparatus for cleaning or de-icing a vehicle window.

BACKGROUND OF THE INVENTION

Various methods and devices are known in the art for providing a spray of heated water or other washing fluid onto the windows of a vehicle. The heated fluid is particularly advantageous in removing ice from the vehicle windshield in cold weather. This ice removal function requires that a driver of the vehicle wait while the fluid is heated, before the windshield can be de-iced. Methods and devices known in the art are impractical for this purpose, however, since they typically use heat or electricity generated by the vehicle engine itself to heat the fluid, requiring the driver to wait an unacceptably long time for the fluid to reach a suitable temperature.

Using the vehicle battery to heat the fluid, independent of the vehicle engine, is also problematic because of the large current draw required to heat a sufficient quantity of fluid to effectively de-ice the windshield. The battery cannot typically provide sufficient current to heat the vehicle's entire reservoir of washing fluid in a reasonable amount of time. Although methods and devices have been suggested for heating the fluid on-line, as it is about to be sprayed on the windshield, the battery also cannot provide enough current to heat a spray of sufficient volume to a high enough temperature to achieve effective de-icing.

U.S. Patent 5,509,606 describes a hot wash device for an automobile windshield, which includes a container into which washing fluid from a reservoir is pumped and in which the fluid is heated by an electrical heating element before it is sprayed onto the windshield. The container is insulated and includes a thermostat that is used to ensure that the temperature of the fluid does not exceed a predetermined maximum. The container is kept full, with heat applied as needed to bring the cold fluid pumped into the container up to the desired temperature.

U.S. Patent 5,118,040 describes electric apparatus for washing window glass of a vehicle. An insulated container is positioned between a reservoir of cold washing fluid and spray outlets to the vehicle window, in a position lower than the reservoir so as to be kept full of fluid. When the vehicle ignition is turned on, an electric heater heats the fluid in the

container and remains active while the vehicle is in use. There is no provision, however, for rapid start-up and heating to de-ice the vehicle window.

U.S. Patent 4,090,668 describes a windshield washing and deicing system which includes a reservoir having a sealed container therein. A pump transfers washer fluid from the reservoir to the container and from the container to a plurality of nozzles. Heated engine coolant is passed through a conduit in the reservoir. Electrical resistance wire heats the fluid in the container whenever the temperature drops below a certain minimum. Solenoid valves direct the spray from the tank to the front or rear window of the vehicle, but there is no suggestion of using the valves for any other fluid control purposes.

U.S. Patent 5,012,977 describes a vehicle window washer in which washer fluid in a reservoir is heated, and in which a pump for spraying the fluid on the vehicle window has a variable outlet pressure. The temperature of the fluid in the reservoir is sensed, and the pump outlet pressure is varied accordingly in an inverse manner with temperature of the washer fluid, so as to maintain a more consistent fluid deposit on the window, as the fluid viscosity changes with temperature.

U.S. Patent 5,354,965 describes a system for electrically heating a volume of windshield cleaning fluid in a motor vehicle. A vessel is filled with the volume of fluid to be heated, using PTC thermistors or other electrical heating elements. A control circuit regulates the length of time that the fluid is heated, in accordance with a prevailing ambient temperature, before the fluid is sprayed on the windshield. The circuit also prevents operation of the fluid heating when the vehicle engine is not running.

PCT Application PCT/ US98/13023, assigned to the present assignee, describes de-icing apparatus in which a vessel is provided for heating a washing fluid before the fluid is discharged toward a window of a vehicle. Before the fluid is introduced into the vessel, the vessel is preheated, preferably by passing an electrical current through a heating element in the vessel for about one minute or less. When preheating is completed, the fluid is allowed into the vessel and is rapidly heated by contact therewith, leading to an increase in pressure in the vessel due to vaporization of a portion of the fluid. The fluid is then discharged at a desired temperature and pressure so as to clean and/or de-ice the window.

Although the preheating of the vessel draws only a moderate electrical input from the vehicle battery, it enables a sufficient quantity of hot fluid to be generated for de-icing the window before starting the vehicle more rapidly than in any practical window cleaning system

known in the art. Moreover, the pressure generated by vaporization of the fluid helps to clear ice or other blockages that may have formed in tubing or nozzles through which the fluid is sprayed onto the window. It is also noted that spraying the heated fluid on the window's exterior surface effectively defogs its interior surface, as well.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide improvements to the apparatus and methods for cleaning or de-icing a vehicle window disclosed in PCT Application PCT/US98/13023.

In preferred embodiments of the present invention, a vessel is provided for heating a washing fluid before the fluid is discharged toward a window of a vehicle. Before the fluid is introduced into the vessel, the vessel is preheated, preferably by passing an electrical current through a heating element in the vessel for about one minute, for example. When preheating is completed, the fluid is allowed into the vessel and is rapidly heated by contact therewith, leading to an increase in pressure in the vessel due to vaporization of a portion of the fluid. The fluid is then discharged at a desired temperature and pressure so as to clean and/or de-ice the window.

Although the preheating of the vessel draws only a moderate electrical input from the vehicle battery, it enables a sufficient quantity of hot fluid to be generated for de-icing the window before starting the vehicle more rapidly than in any practical window cleaning system known in the art.

In some preferred embodiments of the present invention, after an initial quantity of the fluid has been heated and discharged from the vessel, a further quantity is introduced into the vessel and immediately heated. Once the further quantity has reached a desired temperature, it too is discharged, preferably after a delay of several seconds. This process continues for repeated heat/discharge cycles, until the window has been completely cleaned and de-iced. Preferably, the heat/discharge cycles are timed in a sequence whose parameters, such as discharge duration and intervals between discharges, are varied in accordance with ambient temperatures of the vehicle and the unheated fluid.

It will be understood that the term "vehicle" as used in the context of the present patent application and in the claims can refer to any type of wheeled vehicle having windows, such as an automobile or truck, as well as to a boat or airplane. Furthermore, the term "window," although typically referring to a windshield of a vehicle, can refer to any

transparent surface, including side and rear windows and outer mirrors, as well as covers of headlights and the like. In addition, whenever the term "cleaning" is used in the present application and in the claims in reference to an action involving spraying heated fluid on a window, the term will be understood to comprehend de-icing, as well. Those skilled in the art will appreciated that the principles of the present invention may be adapted for cleaning and de-icing other surfaces, including internal windows and mirrors, for example, as well as for supplying fluid for other purposes. For example, the system of the present invention provides a bypass route for washer fluid to be directly sprayed on the windshield for routine cleaning thereof.

There is thus provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window, and a first heating element disposed in the vessel for heating the fluid in the vessel, characterized by an auxiliary heating element being disposed in the vessel for heating the fluid in the vessel, wherein the auxiliary heating element is disposed at a bottom portion of the vessel and is operative to heat a quantity of fluid which is not necessarily sufficient to cover the first heating element.

In accordance with a preferred embodiment of the present invention there is also provided a plurality of sensors which feed data concerning at least one of a temperature and a fluid level of the fluid in the vessel to a controller, the controller controlling energization of the first and auxiliary heating elements in response to the data.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged, a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle window, and a heating element disposed in the vessel for heating the fluid in the vessel, characterized by a temperature sensor mounted in propinquity to the spray head, the temperature sensor being in communication with a controller which controls heating of the heating element in response to a temperature sensed by the temperature sensor.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged, a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle window, and a heating element disposed in the vessel for heating the fluid in the vessel, characterized by a wind speed sensor in communication with a controller, wherein the controller correlates a wind speed sensed by the wind speed sensor to a temperature of the fluid sprayed from the spray head, and controls heating of the heating element in response to the wind speed sensed by the wind speed sensor.

In accordance with a preferred embodiment of the present invention there is also provided a vehicle speed sensor, wherein the controller also correlates a vehicle speed sensed by the vehicle speed sensor to a temperature of the fluid sprayed from the spray head, and controls heating of the heating element in response to the vehicle speed sensed by the vehicle speed sensor.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window, and a first heating element disposed in the vessel for heating the fluid in the vessel, characterized by a pumping system in fluid communication with the reservoir and the vessel which selectively pumps fluid from the reservoir to the vessel and drains the fluid from the vessel back to the reservoir.

In accordance with a preferred embodiment of the present invention the pumping system includes at least one solenoid in fluid communication with the reservoir and the vessel and switchable from a first position to a second position, wherein in the first position the at least one solenoid permits flow from the reservoir to the vessel and substantially prevents draining the fluid from the vessel back to the reservoir, and wherein in the second position the at least one solenoid permits draining the fluid from the vessel back to the reservoir and substantially prevents flow from the reservoir to the vessel.

In accordance with a preferred embodiment of the present invention the pumping system includes a reversible pump which in a first operating orientation pumps the fluid from

the reservoir to the vessel and in a second operating orientation pumps the fluid from the vessel back to the reservoir. Preferably the reversible pump includes a geared pump.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged, a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle window, a windshield wiper for wiping the window, and characterized by the spray head including a multi-outlet spray head that includes a plurality of spray outlets.

In accordance with a preferred embodiment of the present invention a controller is provided which controls a spraying pattern of the plurality of outlets.

In accordance with a preferred embodiment of the present invention a sensor is provided for sensing an angular position of the windshield wiper, wherein the controller controls the spraying pattern of the plurality of outlets in accordance with the angular position of the windshield wiper. A motor is preferably provided which actuates the windshield wiper.

In accordance with a preferred embodiment of the present invention a cam is mounted on the windshield wiper, the cam selectively opening the outlets to permit flow of the fluid therethrough.

In accordance with a preferred embodiment of the present invention a motor is provided which actuates the windshield wiper and a sensor for sensing a torque of the motor, wherein the controller controls the spraying pattern of the plurality of outlets in accordance with the torque of the motor.

In accordance with a preferred embodiment of the present invention the windshield wiper wipes the window between two limits of travel, and the windshield wiper is placeable in a summer parking mode and a winter parking mode, wherein in the summer parking mode, the wiper is at rest generally at one of the limits of travel, and wherein in the winter parking mode, the wiper is between the limits of travel.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged, a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle

window, a windshield wiper for wiping the window, and characterized by the windshield wiper having a longitudinal bore formed therethrough for flow of the fluid therethrough, wherein the bore fluidly communicates with a plurality of outlet holes formed in the wiper for applying the fluid on the window.

In accordance with a preferred embodiment of the present invention the fluid enters the bore at one end of the wiper and an opposite end of the wiper is substantially sealed.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window, and characterized by further including a cartridge which dispenses an additive to the fluid prior to discharging the fluid.

In accordance with a preferred embodiment of the present invention the cartridge includes a solid block of the additive.

Further in accordance with a preferred embodiment of the present invention the cartridge fits into an apertured holder which is sealed by a plug, the plug including a threaded neck and a neck portion formed with a plurality of through holes, the holes being in fluid communication with a bore which is in turn in fluid communication with the apertured holder, and wherein the threaded neck can be screwed into a container through which the fluid can flow into the vessel, wherein the additive is mixed with the fluid as the fluid flows through the container.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window, and characterized by further including a fluid authorization system for verifying use of an authorized fluid.

In accordance with a preferred embodiment of the present invention the fluid authorization system includes a membrane constructed of a material that disintegrates if it is not in the presence of a fluid authorized for use.

There is also provided in accordance with a preferred embodiment of the present invention apparatus for cleaning or de-icing a vehicle window, including a reservoir for

containing therein a washing fluid, a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window, and characterized by further including at least one tube in fluid communication with the fluid and a solenoid which selectively squeezes and seals the at least one tube to prevent passage of the fluid therethrough and selectively permits flow of the fluid therethrough.

In accordance with a preferred embodiment of the present invention apparatus is also provided to prevent damage due to freezing of the fluid.

Further in accordance with a preferred embodiment of the present invention the apparatus to prevent damage includes a platform arranged for sliding in the vessel, the platform being operative to slide due to a force of the fluid pressing thereagainst during freezing of the fluid.

Still further in accordance with a preferred embodiment of the present invention the apparatus to prevent damage includes a cap attached to the vessel and which is operative to move away from the vessel due to a force of the fluid pressing thereagainst during freezing of the fluid.

Additionally in accordance with a preferred embodiment of the present invention apparatus is provided for shutting off electrical supply to the heating element.

In accordance with a preferred embodiment of the present invention the apparatus for shutting off electrical supply includes a fuse electrically connected to the heating element.

Further in accordance with a preferred embodiment of the present invention the fuse is internal to the vessel and is in contact with the washing fluid in the vessel.

Still further in accordance with a preferred embodiment of the present invention the fuse includes a body to which is soldered a cap portion at a soldered connection, the cap portion being biased by a biasing device, the fuse being electrically connected to the heating element through the soldered connection, wherein upon reaching a predetermined temperature, the soldered connection becomes weakened due to at least partial melting thereof, and the biasing device urges the cap portion off the body, thereby causing a break in electrical supply to the heating element.

Additionally in accordance with a preferred embodiment of the present invention the fuse is mounted on a base which is sealed with respect to the vessel by means of an endcap which presses the base against an O-ring mounted on the vessel.

In accordance with a preferred embodiment of the present invention the apparatus for shutting off electrical supply includes a fuse which is physically internal to and electrically connected to the heating element.

Further in accordance with a preferred embodiment of the present invention the apparatus for shutting off electrical supply includes a first FET in electrical communication with the controller, a fuse external to the vessel and operatively connected to the first FET, a second FET operatively connected to the fuse, the second FET in communication with at least one of the temperature sensor, a thermostat mounted in the vessel, and logic circuitry in electrical communication with the second FET.

In accordance with a preferred embodiment of the present invention if no command signal is sent to the first FET from the controller, the first FET is open and the heating element is not energized. If a command signal is sent to the first FET from the controller, the first FET is closed and the heating element is energized. If no command signal is sent to the first FET from the controller, but a near zero voltage drop exists across the first FET, then the second FET is commanded to close, thereby sending a current through the fuse which breaks the fuse and disconnects electrical supply to the heating element. If a command signal is sent to the first FET from the controller, but a voltage drop generally greater than zero exists across the first FET, then the apparatus for cleaning or de-icing a vehicle window is commanded to shut down.

Further in accordance with a preferred embodiment of the present invention a solenoid is in direct electrical communication with a control circuit printed circuit board (PCB) mounted in the vessel, the solenoid determining whether the fluid flows directly to the spray head or flows to the spray head via the vessel. The solenoid is preferably attached to the PCB.

In accordance with a preferred embodiment of the present invention the PCB is selectively connectable to a vehicle computer, wherein operation of the solenoid and the apparatus for cleaning or de-icing a vehicle window is controllable by at least one of the PCB and the vehicle computer.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood from the following detailed description of the preferred embodiments thereof, taken together with the drawings in which:

Fig. 1 is a schematic, pictorial illustration showing apparatus for cleaning a windshield of an automobile with heated washing fluid, in accordance with a preferred embodiment of the present invention;

Fig. 2 is a schematic diagram showing details of the cleaning apparatus of Fig. 1, in accordance with a preferred embodiment of the present invention;

Fig. 3 is a simplified pictorial illustration of a filling and drainage pumping system useful in the window de-icing and cleaning apparatus of Fig. 2, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 4 is a simplified pictorial illustration of a filling and drainage pumping system useful in the window de-icing and cleaning apparatus of Fig. 2, constructed and operative in accordance with another preferred embodiment of the present invention;

Fig. 5 is a timing diagram illustrating operation of the apparatus of Fig. 1, in accordance with a preferred embodiment of the present invention;

Fig. 6 is a simplified pictorial illustration of a multi-outlet spray head constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 7 is a simplified pictorial illustration of a multi-outlet spray head constructed and operative in accordance with another preferred embodiment of the present invention;

Figs. 8 and 9 are simplified pictorial illustrations of a windshield wiper actuator system constructed and operative in accordance with a preferred embodiment of the present invention, wherein Fig. 8 illustrates a summer parking mode and Fig. 9 illustrates a winter parking mode;

Fig. 10 is a simplified block diagram of the windshield wiper actuator system of Figs. 8 and 9;

Figs. 11A-11F are simplified illustrations of a typical operating sequence of the windshield wiper actuator system of Figs. 8 and 9, in accordance with a preferred embodiment of the present invention;

Fig. 12 is a simplified illustration of a cam system for controlling a spray head during the operating sequence of the windshield wiper actuator system of Figs. 11A-11F, in accordance with a preferred embodiment of the present invention;

Figs. 13 and 14 are simplified pictorial and sectional illustrations, respectively, of a windshield wiper constructed and operative in accordance with a preferred embodiment of the present invention, Fig. 14 being taken along lines XIV-XIV in Fig. 13;

Fig. 15 is a simplified, partially sectional illustration of a cartridge containing an additive which can be added to the fluid used in the windshield wiper cleaning apparatus of Fig. 1, constructed in accordance with a preferred embodiment of the present invention, wherein the cartridge is installed in the system and the additive flows into solution with the fluid;

Fig. 16 is a simplified pictorial illustration of the cartridge of Fig. 15;

Fig. 17 is a simplified pictorial illustration of a carrier for a plurality of such cartridges;

Fig. 18 is a simplified, partially sectional illustration of a fluid authorization system for verifying use of an authorized fluid in the windshield wiper cleaning apparatus of Fig. 1, constructed in accordance with a preferred embodiment of the present invention;

Figs. 19A and 19B are simplified, partially sectional illustrations of a solenoid constructed in accordance with a preferred embodiment of the present invention, and useful in the windshield wiper cleaning apparatus of the present invention, Fig. 19B taken along lines 19B-19B in Fig. 19A;

Fig. 20 is a simplified sectional illustration of apparatus to prevent damage due to freezing of the fluid in the windshield wiper cleaning apparatus of Fig. 1, constructed in accordance with a preferred embodiment of the present invention;

Fig. 21 is a simplified pictorial illustration of apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage due to overheating, constructed in accordance with a preferred embodiment of the present invention;

Fig. 22 is a simplified pictorial illustration of the apparatus of Fig. 21 assembled with a heater element of the windshield wiper cleaning apparatus of Fig. 1;

Fig. 23 is a simplified sectional illustration of apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage due to overheating, constructed in accordance with another preferred embodiment of the present invention;

Fig. 24 is a simplified sectional illustration of apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage due to overheating, constructed in accordance with yet another preferred embodiment of the present invention;

Fig. 25 is a simplified block diagram illustration of apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage due to overheating, constructed in accordance with still another preferred embodiment of the present invention; and

Figs. 26-29 are simplified sectional illustrations of a solenoid useful in the windshield wiper cleaning apparatus of Fig. 1, constructed in accordance with another preferred embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is now made to Fig. 1, which is a schematic pictorial illustration showing electrically powered window de-icing and cleaning apparatus 20 for vehicles, in accordance with a preferred embodiment of the present invention, shown assembled for use in an automobile 22 having a windshield 24 coated with ice 26.

A heatable vessel 28 for windshield washing fluid is connected between a washing fluid reservoir 30 of automobile 22 and spray heads 32, which spray the fluid onto windshield 24 when actuated by an operator 25 of the automobile. The operator may actuate the apparatus either from inside or outside automobile 22, such as by means of a remote control 90, as shown in Fig. 1 and described further hereinbelow. Vessel 28 has an inlet port 34, which receives washer fluid from reservoir 30, and an outlet port 36 through which heated fluid is discharged to spray heads 32. The fluid is driven by a pump 40, which is generally already present in automobile 22 for spraying unheated fluid to clean windshield 24. A battery 42 provides power to apparatus 20, and wipers 44 clean melted ice and dirt from the windshield, as is known in the art. A controller 46 regulates the operation of apparatus 20, and optionally also controls wipers 44 in conjunction with operation of the apparatus. Other aspects and details of the apparatus 20 are described further hereinbelow.

Reference is now made to Fig. 2 which shows details of vessel 28 and other elements of apparatus 20, in accordance with a preferred embodiment of the present invention. Vessel 28 is generally cylindrical in shape and comprises an inner chamber 52 surrounded by an outer chamber 54. Inner chamber 52 is contained and defined by an inner wall 56, preferably constructed of a metal such as stainless steel. Outer chamber 54 is surrounded by an outer wall 58 of the vessel, preferably constructed of an insulating material, such as a plastic. A heating element 50 inside inner chamber 52 heats the fluid in vessel 28. As a result of the concentric arrangement of chambers 52 and 54, heat losses from vessel 28 are minimized,

since heat lost by the hot fluid in chamber 52 is used largely to pre-heat the colder fluid in chamber 54. Since the fluid in chamber 54 is cooler, its heat losses through outer wall 58 are relatively small.

Heating element 50 preferably comprises a resistively-heated electrical element, which is powered by battery 42 via controller 46, in accordance with a heating sequence described further hereinbelow. Alternatively or additionally, element 50 may be heated by exchange of heat with a heat source in automobile 22, such as the engine cooling fluid or exhaust. Electrical heating by battery 42 is advantageous, however, since it allows vessel 28 to be heated rapidly even before the automobile is started. Preferably, element 50 draws approximately 400 W, which typical automobile batteries can supply easily. Moreover, vessel 28 is preferably sized so that within about one minute or less of actuation, it is capable of heating and discharging fluid of a volume and temperature sufficient to melt ice 26. For this purpose, inner chamber 52 preferably contains about 50 ml of the fluid. It will be appreciated, however, that the principles of the present invention may similarly be applied by scaling the volume of vessel 28 and the power of element 50 to any required capacity. In particular, when apparatus 20 is used in larger vehicles, such as trucks or boats, the volume and power draw of the vessel will typically be substantially larger than in automobile 22.

After an initial quantity of heated fluid has been discharged, pump 40 and inlet valve 66 are operated to refill vessel 28. Although heating element 50 and wall 56 are no longer as hot as they were before the initial quantity of the fluid was introduced into the vessel, they still retain some residual heat, facilitating rapid heating of the refilled fluid. When the refilled fluid reaches a desired temperature, preferably with heating element 50 reaching a temperature of several hundred °C, and/or after a predetermined period of time, it is discharged through spray heads 32. This process is repeated a desired number of times in sequence, until an entire sequence of discharges has been completed, as described hereinbelow, or until the windshield has been cleaned and/or de-iced, or until the temperature in vessel 28 drops below a predetermined minimum, or until it is interrupted by operator 25. The driver may then again actuate apparatus 20 and begin a new cycle of heating and fluid discharge.

Preferably, each time vessel 28 is refilled, heated fluid is discharged through the spray heads 32 for about 3 sec, at intervals of about 5 sec or longer between fills, generally as determined by the time needed for the fluid to reach a desired temperature, such as 80-100 °C. The temperature of later discharges in the sequence may be less than that of the initial and

other earlier discharges. Further preferably, wipers 44 are operated in cooperation with the discharge of fluid from apparatus 20, so that the wipers 44 go on only during and shortly after the fluid discharge. Optionally, wiper operation may be delayed, so that the wipers do not operate during the initial discharge, when ice 26 has not yet melted, but only start from the second and subsequent discharges.

After the sequence of discharges of heated fluid is completed, valve 66 is closed (relative to vessel 28), and drain valve 62 is preferably opened, so that any fluid remaining in the vessel can drain back into reservoir 30. Pump 40 is generally not sealed against back-flow. Accordingly a pressure relief valve 73 is preferably provided to relieve any fluid pressure build-up in such a case. Pressure relief valve 73 allows the fluid to flow back to reservoir 30 in the event of over-pressure. An upper end 61 of drain port 60 is preferably elevated relative to the bottom of chamber 52, so that a minimal amount of fluid will be left in vessel 28 even after draining. The vessel is then ready for rapid operation the next time apparatus 20 is actuated.

Bypass line 76 allows unheated fluid from reservoir 30 to be pumped directly to spray heads 32, without passing through vessel 28. Line 76 is open to spray heads 32 whenever a valve 74, preferably a three-way valve, is closed relative to outlet port 36. Line 76 can be used in warm weather, when de-icing is not needed, or when a cleaning spray is needed immediately, and there is not time to heat the fluid. Valve 74 preferably remains open relative to line 76, so that fluid from the line is conveyed to spray heads 32, whenever the heating apparatus is not actuated. A one-way valve 80 in line 76 preferably blocks any back-flow of fluid through the line.

Apparatus 20 thus provides additional window-cleaning functionality for automobile 22, at relatively low cost and without interfering with pre-existing window washing capabilities. The apparatus may either be installed as part of the window washing system in a new automobile, or it may easily be retrofitted into an existing washing system. Although the parts of apparatus 20 are shown in Figs. 1 and 2 as being in certain positions and orientations relative to automobile 22 and the washing system therein, other positions and orientations are clearly possible. For example, vessel 28 may be placed at a different angle from the orientation shown in the figures, as long as ports 34, 36 and 60 are suitably positioned and oriented in the vessel.

Control of apparatus 20 by controller 46 is described hereinabove as being based on feedback to the controller provided by a sensor 64. This sensor is shown in Fig. 2 as being placed at the upper end of vessel 28, where it will measure the temperature either of vapor or fluid in chamber 52, depending on whether the chamber is empty or filled. Controller 46 preferably tracks and monitors changes in temperature sensed by sensor 64 during heat/fill/discharge cycles of vessel 28. If the temperature exceeds a predetermined maximum, or if temperature changes do not follow a predetermined normal profile, the controller will conclude that a malfunction has occurred, such as blockage of inlet 34 or outlet 36 or a failure of sensor 64, and will preferably interrupt operation of the apparatus and notify operator 25 by an appropriate signal.

In addition or alternative to sensor 64, there may be a temperature sensor 301 nearer the bottom of vessel 28, to measure the fluid temperature thereat, or a temperature sensor 302 mounted in, on or near heating element 50. Other sensors, such as a pressure sensor or pressure-stat or a fluid level sensor 303, may also be fixed in the vessel and provide feedback to controller 46. Further temperature sensors may also be used, including a sensor 82 on an outer surface of vessel 28, a sensor 84 in reservoir 30 for measuring the temperature of fluid therein, and a sensor 86 on an outer surface of automobile 22, most preferably on windshield 24. These sensors provide inputs to controller 46, which accordingly sets parameters such as the voltage applied to element 50 and/or the lengths of time for which the element and fluid in vessel 28 are heated.

Preferably, the controller sets the parameters so that the fluid is sprayed onto windshield 24 at a temperature high enough to melt ice 26 quickly under prevalent ambient conditions, as indicated by sensor 86, for example, but not so high (relative to the temperature of the windshield) as to create a danger of cracking the windshield or violating safety regulations in this regard. The selection of the parameters is preferably automatic, without requiring intervention by operator 25 of automobile 22, except to actuate or de-actuate apparatus 20 as desired.

The aforementioned description is that of the apparatus disclosed in PCT Application PCT/ US98/13023. Improvements to this apparatus are now described, first with reference to Fig. 2.

In addition or alternative to sensor 64, a temperature sensor 304 is preferably mounted on or near each spray head 32. Temperature sensor 304 may additionally be mounted at a tee-

connection 305 of the spray heads. Temperatures of the spray heads 32 are input to controller 46 and provide further feedback control for setting parameters such as the voltage applied to element 50 and/or the lengths of time for which the element and fluid in vessel 28 are heated.

During initial heating of vessel 28, there is generally a small quantity of fluid remaining therein, as mentioned hereinabove, and as shown in Fig. 2. It is seen that for such a small quantity of fluid, heating element 50 may not be submerged in the fluid, but rather may be exposed for most of its length to air inside vessel 28. In such a case, energizing heating element 50 may be wasteful, and worse, could cause damage from overheating. To solve this problem, an auxiliary heating element 306 is preferably disposed at the bottom of vessel 28. Heating element 306 may be shaped as a coil heater, for example, or any other suitable low-profile shape.

Heating element 306 is preferably connected to and controlled by controller 46, as is now described. If the amount of fluid in vessel 28 is sufficient to cover heating element 306 but not the majority of heating element 50, then it will take heating element 306 a relatively short time to heat fluid to a predetermined temperature, such as the boiling point. If, however, the amount of fluid in vessel 28 is sufficient to cover both heating elements 50 and 306, then it will take heating element 306 a longer time to heat fluid to the predetermined temperature. Temperature sensors 301 and 302, as well as fluid level sensors 303 and 309 or any other optional sensors mounted in vessel 28, may be used to monitor the time needed for the predetermined temperature rise, which time is processed by controller 46 to control heating of heating elements 50 and 306. For example, if the monitored time is relatively short, i.e., below a predetermined threshold, controller 46 interprets this to mean that the fluid covers only heating element 306, and thus only heating element 306 is energized and not heating element 50. If the time equals or exceeds the predetermined threshold, controller 46 interprets this to mean that the fluid sufficiently covers both heating elements 50 and 306, and thus both heating elements 50 and 306 are energized.

As mentioned above, control of apparatus 20 by controller 46 is described as being based on feedback to the controller provided by sensor 64. As an added safety feature, in the event of a failure in the control system, a thermoswitch 308, not connected to controller, may be provided at the upper end of vessel 28, which monitors the temperature either of vapor or fluid in chamber 52, depending on whether the chamber is empty or filled. If the temperature exceeds a predetermined maximum, thermoswitch 308 independently shuts down operation of

the apparatus, even in the event of a failure in the electrical system of the vehicle or apparatus 20, and optionally, may notify operator 25 by an appropriate signal.

Reference is now made to Fig. 3 which illustrates a filling and drainage pumping system 310 useful in window de-icing and cleaning apparatus 20, constructed and operative in accordance with a preferred embodiment of the present invention. In the embodiment of Fig. 3, system 310 preferably employs pump 40 described hereinabove. Pump 40 is preferably a centrifugal water pump which means it is an irreversible pump, i.e., fluid flows generally from an inlet 40A to an outlet 40B.

In accordance with a preferred embodiment of the present invention, a first solenoid 312 is in fluid communication between inlet 40A of pump 40 and reservoir 30. An interface port 314 of solenoid 312 is preferably connected to reservoir 30 via a fluid line 324 and an outlet port 315 is preferably connected to inlet 40A via a fluid line 326 and a tee-connector 316. Similarly, a second solenoid 318 is preferably in fluid communication between outlet 40B of pump 40 and vessel 28. An interface port 320 of solenoid 318 is preferably connected to inlet port 34 via a fluid line 328 and a tee-connector 330. Another port 319 of solenoid 318 is preferably connected to outlet 40B via a tee-connector 322 and a fluid line 327.

In the normally open position of solenoid 312, port 315 is open and a third port 340 is closed. Similarly, in the normally open position of solenoid 318, port 319 is open and a third port 336 is closed. Conversely, in the closed position of solenoid 312, port 315 is closed and third port 340 is open, and in the closed position of solenoid 318, port 319 is closed and third port 336 is open. Control of solenoids 312 and 318, as well as the other elements of system 310, is preferably accomplished by means of controller 46. In accordance with a preferred embodiment of the present invention, solenoids 312 and 318 may be constructed as shown and described hereinbelow with reference to Figs. 19A and 19B.

Pumping system 310 is used to fill vessel 28 when the solenoids are preferably in the normally open position. Pump 40 is operated to draw fluid from reservoir 30 through fluid line 324 (in the direction of the solid line in Fig. 3) to solenoid 312. The fluid enters port 314 and flows out open port 315 through fluid line 326, past tee-connector 316 to inlet 40A of pump 40. It is noted that fluid does not flow from tee-connector 316 to solenoid 318 because port 336 is closed. The fluid flows from outlet 40B of pump 40 past tee-connector 322 via fluid line 327 to open port 319 of solenoid 318. Flow exits solenoid 318 via port 320 and fluid line 328 (in the direction of the solid line in Fig. 3) to tee-connector 330.

Vessel 28 is preferably equipped with a one-way valve 334 which permits fluid flow only out of drain port 60. Therefore, the fluid can only flow from tee-connector 330 to inlet port 34 which preferably comprises a valve (herein also referred to as a valve 34). Valve 34 is opened by controller 46, and the fluid fills vessel 28.

When it is desired to drain fluid from vessel 28, the solenoids are energized to be in the closed position. The pumping action of pump 40 causes fluid to be drained out of drain port 60 and to flow via one-way valve 334 to tee-connector 330. Valve 34 is closed by controller 46 so that the fluid is forced to flow in fluid line 328 (in the direction of the dashed line in Fig. 3) to port 320 of solenoid 318. Since port 319 is closed, fluid flows out of port 336 of solenoid 318 via a fluid line 338 to tee-connector 316 (in the direction of the dashed line in Fig. 3). Since port 315 of solenoid 312 is closed, the fluid can only flow from tee-connector 316 to inlet 40A of pump 40. The fluid exits outlet 40B of pump 40 and flows to tee-connector 322. Since port 319 of solenoid 318 is closed, the fluid can only flow from tee-connector 322 to port 340 of solenoid 312 (in the direction of the dashed line in Fig. 3). The fluid then exits port 314 of solenoid 312 back to reservoir 30 (in the direction of the dashed line in Fig. 3), and the drainage is complete.

Reference is now made to Fig. 4 which illustrates a filling and drainage pumping system 350 useful in window de-icing and cleaning apparatus 20, constructed and operative in accordance with another preferred embodiment of the present invention. Pumping system 350 is similarly constructed to pumping system 310, with like elements being designated by like numerals. (Pressure relief valve 73 and other elements are not shown for the sake of simplicity.) Pumping system 350 differs from system 310 in that system 350 preferably employs a reversible pump 352, such as a geared pump, i.e., fluid can flow both in and out of an first port 352A and a second port 352B. In addition, in pumping system 350 there is no need for solenoids.

When it is desired to fill vessel 28 with fluid, pump 352 is operated so that the fluid is pumped in the direction of arrows 356. The fluid flows from reservoir 30 via fluid line 324 through pump 352, thence via fluid line 328 to tee-connector 330, finally entering and filling vessel 28 via open valve 34, since the fluid cannot flow past one-way valve 334.

When it is desired to drain fluid from vessel 28, the pumping direction of pump 352 is reversed so that pump 352 now pumps fluid in the direction of arrows 354. Fluid is drained out of drain port 60 and flows via one-way valve 334 to tee-connector 330. Valve 34 is closed

so that the fluid is forced to flow in fluid line 328 back to pump 352, thence to reservoir 30, and the drainage is complete.

Reference is now made to Fig. 5 which is a timing diagram illustrating a sequence 96 of heat/fill/discharge cycles of apparatus 20, in accordance with a preferred embodiment of the present invention. The pumping system used may be the reversible pumping system of Fig. 4. In such a case, the pumping system may pump fluid towards vessel 28 (indicated by a positive ordinate in the graph) or it may drain fluid from vessel 28 (indicated by a negative ordinate in the graph). It is noted that pump 352 may be actuated intermittently when needed, or alternatively, pump 352 may be actuated continuously and controller 46 may be used to switch pump 352 between filling mode or draining mode as desired.

Initially, as described hereinabove, drain valve 62 is opened and heating element 306 and/or heating element 50 are energized to pre-heat vessel 28. Valve 62 is closed, preferably after about 15 sec. Alternatively, the drain valve may be held closed for a short period, preferably about 20 sec, so that the fluid in vessel 28 is heated to a high temperature before the valve is opened. This alternative is particularly useful if controller 46 determines that one of the valves, particularly inlet valve 66, is stuck and will not open, in which case the heated fluid is used to force the valve open.

Heating continues until sensors 64 or 301 reaches a target temperature, preferably about 85°C (dependent on the exact position of the sensor), in chamber 52, or for about 70 sec, if the temperature does not reach the target temperature. At that point, pump 40 and inlet and outlet valves 66 and 74 open, to admit and discharge the initial quantity of fluid. The temperature in chamber 52 drops, and is subsequently reheated, preferably to about 60°C, whereupon a second quantity of the fluid is admitted and discharged. The process of reheating, fill and discharge continues for a predetermined number of cycles, or until terminated by operator 25.

After the final discharge in sequence 96, drain valve 62 is opened, and heating elements 50 and/or 306, which are energized substantially continuously throughout the sequence, remain energized for about 15 sec more, in order to heat and drive out of vessel 28 as much as possible of any fluid remaining therein, down to the level of upper end 61. The apparatus is then ready to begin the next sequence, when required by the user. Most preferably, as seen in Fig. 5, heating element 306 is first energized before heating element 50, there preferably being a delay of about 2-10 sec before energization of heating element 50.

Similarly, most preferably, heating element 50 is turned off at the end of the cycle before heating element 306. The delays at the beginning and end of the cycles between heating elements 50 and 306 are preferably part of the working cycle so as to prevent overheating of heating element 50 and to ensure proper initial heating of the quantity of fluid left in the bottom of vessel 28.

In the mode of operation described with reference to Fig. 5, it is possible that cold fluid may remain in the fluid lines in the direction of the spray heads. This is undesirable because the very first spray of fluid on the windshield would then be cold, and only afterwards would heated fluid reach the windshield. In contrast to the mode of operation described with reference to Fig. 5, a different mode of operation may be employed in order to prevent this phenomenon. The pumping system may be stopped while the fluid is still flowing towards vessel 28 (due to inertial movement), and only after a *delay*, the fluid may be re-routed, by means of the valve, from the direction towards vessel 28 to the direction towards the spray heads. In this way, any cold fluid which may remain in the fluid lines, only flows into vessel 28 and does not flow towards the spray heads.

Reference is now made to Fig. 6 which illustrates a multi-outlet spray head 360 constructed and operative in accordance with a preferred embodiment of the present invention. Multi-outlet spray head 360 preferably includes a plurality of outlets, such as a central outlet 362 and two outer outlets 364 and 366, although any number of outlets may also be employed. In the embodiment of Fig. 6, the outlets are fed fluid preferably via a solenoid 368. Solenoid 368 has an inlet 382 into which fluid can flow from a pressurized fluid source. The fluid preferably exits solenoid 368 from an outlet 372 via a tee-connector 374 to spray head outlets 364 and 366. Fluid is preferably fed directly from the pressurized fluid source via a tee-connection to central outlet 362.

In the normally open position of solenoid 368, port 372 is open and a third port 378 is closed. Conversely, in the closed position of solenoid 368, port 372 is closed and third port 378 is open. However, in the embodiment of Fig. 6, third outlet 378 is plugged and not in use.

In the embodiment of Fig. 6, the flow of fluid from spray head 360 can be controlled, such as by means of controller 46, to spray out of the outlets in a variety of manners. For example, controller 46 can energize solenoid 368 to a closed position such that the fluid initially exits central outlet 362 only, with no fluid initially exiting outlets 364 and 366. After some initial delay, solenoid 368 can be opened so that the fluid exits outlets 364 and 366, the

fluid exiting these two outlets substantially simultaneously. Controller 46 can then continue spraying from outlet 362, as well as outlets 364 and 366, or can cause any kind of combination of intermittent and continuous spraying from the three outlets. It is noted that in the embodiment of Fig. 6, outlets 364 and 366 always spray together.

Reference is now made to Fig. 7 which illustrates a multi-outlet spray head 360 constructed and operative in accordance with another preferred embodiment of the present invention, in which there is no tee-connector 374. Port 372 feeds spray head outlet 364 and third port 378 feeds spray head outlet 366.

In the embodiment of Fig. 7, the flow of fluid from spray head 360 can be controlled, such as by means of controller 46, to spray out of the outlets in a variety of manners. For example, controller 46 can close solenoid 368 such that the fluid initially exits central outlet 362 and outlet 366, with no fluid exiting outlet 364. After some initial delay, solenoid 368 can be opened so that the fluid exits central outlet 362 and outlet 364, with no fluid exiting outlet 366. It is also possible to place solenoid 368 in a partially open position wherein fluid can exit both outlets 364 and 366, as well as central outlet 362. The difference between the embodiments shown in Figs. 6 and 7 is that in the embodiment of Fig. 6, outlets 364 and 366 always spray together, whereas in the embodiment of Fig. 7, outlets 364 and 366 spray independently of each other. It is thus appreciated that in general a greater variety of spray patterns are possible with the embodiment of Fig. 7 than with the embodiment of Fig. 6.

Reference is now made to Figs. 8 and 9 which illustrate a windshield wiper actuator system 400 constructed and operative in accordance with a preferred embodiment of the present invention. Windshield wiper actuator system 400 is capable of placing windshield wipers 402 and 404 in either summer parking mode (Fig. 8) or winter parking mode (Fig. 9).

Windshield wiper actuator system 400 preferably includes a motor 406 which is connected to the wipers by means of a bar 408 which is pivotally attached to a linkage arm 410 which is in turn pivotally connected by means of linkage members 412 and 414 to wipers 402 and 404, respectively. The limits of travel of linkage members 412 and 414 are shown in phantom lines in Figs. 8 and 9. It is seen that preferably sensors are provided for sensing the limits of the travel. For example, in the illustrated embodiment, a pair of microswitches 416 and 418 are provided. In the summer parking mode, the wipers 402 and 404 are brought to a horizontal or near horizontal position and a contact 420 of motor 406 actuates microswitch 416. In the winter parking mode, the wipers 402 and 404 are brought to a non-horizontal

position, possibly even a vertical position, and contact 420 actuates microswitch 418. It is appreciated that other sensors may be used instead of microswitches, such as Hall effect sensors, to sense the limits of travel.

In the summer parking mode the wipers are at rest in a horizontal or near horizontal position, since in the summer there is generally no ice. However, in the winter, if there is a build-up of ice, the wipers may become stuck to the windshield, or even if not, the build-up of ice may prevent movement of the wipers. If the wipers were to be initially in a horizontal position, at the beginning of de-icing the wipers would start to move only at the bottom portion of the windshield, and the initially cleared area of the windshield would still not provide a convenient viewing area for safe driving. The driver would have to wait until the de-icing apparatus had melted a sufficient amount of ice for the wipers to be able to swing up to clear a visible swath on the windshield for safe driving. By bringing the wipers to the non-horizontal winter parking mode, the *initially* cleared area of the windshield, at the beginning of the de-icing process, *already* provides a convenient viewing area for safe driving.

It is noted that in Fig. 9 washer fluid (reference numeral 407) is discharged from wipers 402 and 404 themselves, such an embodiment being shown and described hereinbelow with reference to Figs. 13 and 14.

Reference is now made to Fig. 10 which illustrates a simplified block diagram of windshield wiper actuator system 400. Motor 406 is preferably controlled by a wiper controller 422 which preferably drives motor 406 via a power driver 424. Microswitches 416 and 418 are preferably in electrical communication with controller 422. Temperature sensors 64 or 304 are preferably in electrical communication with controller 422 as well. A shaft encoder 426 is preferably provided that can sense the rotation of motor 406 and thus the rotation of the wipers as well. Shaft encoder 426 can also counts the number of pulses of motor 406 during operation of the wipers, the importance of which will be described further hereinbelow.

Another example of sensors which may provide data to controller 46 in order to control heating of heating elements 50 and 306, are a wind speed sensor 57 and a vehicle speed sensor 59, the latter preferably being the standard speed sensor used with the speedometer of the vehicle. Wind can cool the fluid before it reaches the windshield. Accordingly, controller 46 can correlate the wind speed in terms of thermal effect on the fluid temperature and compensate therefor by heating the fluid to a higher temperature before

spraying on the windshield. Alternatively, if there is no appreciable wind, controller 46 can save electricity and heat the fluid to a slightly lower temperature.

The driver can bring windshield wiper actuator system 400 into winter parking mode manually. Alternatively, system 400 may be automatically actuated. For example, temperature sensors 64 or 304, or a temperature sensor on the outside of the vehicle, may be used to sense a drop in temperature during the night, and the sensed change in temperature is interpreted by controller 422 to bring the windshield wipers to winter parking mode.

As mentioned above, when there is a build-up of ice, the wipers may become stuck to the windshield, or even if not, the build-up of ice may prevent movement of the wipers. At this initial stage, motor 406 is called upon to produce a large amount of torque and may become overheated or damaged. Therefore, it is important to prevent such damage to motor 406. This can be accomplished in several ways. For example, shaft encoder 426 or the commutation of motor 406 can be used to count the number of pulses of motor 406 during operation of the wipers. Controller 422 can compare the number of pulses with a predetermined amount to interpret whether or not motor 406 is being overworked. If motor 406 is being overworked, then controller 422 can shut down operation of motor 406 to prevent damage thereto.

As another example, since the electrical signal from controller 422 to driver 424 is generally proportional to the current output from driver 424 to motor 426, an intolerable rise in the output current of driver 424 can be used to indicate overheating of motor 406. In such a case, of course, there is no need for shaft encoder 426.

As a further example, the actuation or non-actuation of microswitches 416 and 418 provides controllers 46 and 422 with an indication of the clockwise or counterclockwise movement of wipers 402 and 404. By simply sensing which microswitch is actuated before the other, controllers 46 and 422 can tell the direction of the wiper movement. Even for small movements of the wipers, wherein only one microswitch may be actuated, controllers 46 and 422 can still sense the direction of movement of the wipers. The number of times the particular microswitch is actuated, or alternatively, the number of pulses of motor 406 can indicate the movement of the wipers. In addition, microswitches 416 and 418 can be used to monitor any possible overloading of motor 406, without any need for shaft encoder 426 or even driver 424. For example, contact 420 of motor 406 may be in initial contact with microswitch 416. If there is no obstruction to movement of the wipers, motor 406 will start to

rotate and microswitch 416 will be released. If however there is an obstruction to movement of the wipers, motor 406 will stall somewhat and microswitch 416 will not be released. Controller 422 can then interpret the release or non-release of microswitch 416 to detect and prevent overheating of motor 406.

Reference is now made to Figs. 11A-11F which illustrate a typical operating sequence of windshield wiper actuator system 400 in accordance with a preferred embodiment of the present invention. In the description that follows, the fluid is sprayed from spray head 360 (Fig. 7), but it is appreciated that other spray heads could also be used.

In Fig. 11A, wipers 402 and 404 are in the winter parking mode and as such are positioned at some non-horizontal position. Central outlet 362 and outlet 364 of spray head 360 spray fluid at zones 430 and 432 in order to start melting ice accumulated on the windshield. Motor 406 tries to swing the wipers in a clockwise direction indicated by an arrow 434. The torque of motor 406 is measured for a predetermined period of time, such as 0.5 sec. If the torque reaches some predetermined value, controller 422 shuts down motor 406.

In Fig. 11B, central outlet 362 and outlet 364 of spray head 360 continue to spray fluid at zones 430 and 432. Motor 406 tries to swing the wipers in a counterclockwise direction indicated by an arrow 436. The torque of motor 406 is again measured for a predetermined period of time, and if the torque reaches some predetermined value, controller 422 shuts down motor 406.

In Fig. 11C, central outlet 362 and outlet 364 of spray head 360 continue to spray fluid at zones 430 and 432. By this time, the fluid has succeeded in melting some of the ice. Motor 406 now succeeds in swinging the wipers both in clockwise and counterclockwise directions (arrows 434 and 436). When the torque of motor 406 reaches some predetermined level, controller 422 switches the swing direction of the wipers from clockwise to counterclockwise and vice versa.

In Fig. 11D, outlet 366 starts to spray fluid at a zone 438, and outlet 364 is temporarily shut down. Central outlet 362 continues to spray fluid. Motor 406 now tries to swing the wipers in the counterclockwise direction so as to start cleaning a further swath on the windshield. It is appreciated that alternatively, outlet 364 may remain open to continue spraying fluid on the windshield. It is also appreciated that a variety of spray patterns may be employed in cleaning and de-icing the windshield and the abovementioned pattern is just one of these possibilities.

In Fig. 11E, the swath of the wipers has increased and more of the windshield is clean. In Fig. 11F, the fluid has succeeded in melting the ice and the wipers swing freely across the windshield.

Spray head 360 is preferably controlled by controller 46, as mentioned above. The control of the spray heads may be accomplished in any suitable manner, electronically or mechanically, for example. An example of a novel way of controlling the spray heads is now described.

Reference is now made to Fig. 12 which illustrates a cam system 440 for controlling spray head 360 during the operating sequence of windshield wiper actuator system 400, in accordance with a preferred embodiment of the present invention. In cam system 440, outlets 362, 364 and 366 are preferably regulated by individual valves 442, 444 and 446, respectively. The valves may be electronic valves or solenoids, for example. The valves are equipped with push rods 448, 450 and 452, respectively, which are actuated by a cam 454 attached to the wiper 402 or 404.

The cam surface of cam 454 is designed in accordance with a desired spray pattern. For example, as shown in Fig. 12, cam 454 may initially push down on rods 448 and 450 to actuate valves 442 and 444 to allow spraying from outlets 362 and 364, while initially rod 452 is not pushed down by cam 454 and thus outlet 366 is initially closed. As wiper 402 or 404 swings in the counterclockwise direction, cam 454 pushes down on rod 452 and opens outlet 366 for spraying therethrough, all the while outlets 362 and 364 remaining open. It is appreciated that a variety of spray patterns may be employed in cleaning and de-icing the windshield and the abovementioned pattern is just one of these possibilities.

Reference is now made to Figs. 13 and 14 which illustrate a windshield wiper 460 constructed and operative in accordance with a preferred embodiment of the present invention. Windshield wiper 460 preferably has a longitudinal bore 462 formed therethrough for flow of fluid therethrough. Bore 462 fluidly communicates with a plurality of outlet holes 464 for applying the fluid on a windshield. A blade 466 extends from a body 468 of wiper 460 for cleaning the windshield. Fluid preferably enters bore 462 at one end 470 of wiper 460, an opposite end 472 being substantially sealed.

Reference is now made to Figs. 15 and 16 which illustrate a cartridge 480 useful in the windshield wiper cleaning apparatus of the present invention, such as that of Fig. 1, constructed in accordance with a preferred embodiment of the present invention. The fluid

used in the windshield wiper cleaning apparatus of the present invention is any kind of suitable windshield washer fluid, and as such may contain an additive such as anti-freeze, for example. Cartridge 480 is a convenient device for adding such an additive to the windshield washer fluid.

Referring to Fig. 16, cartridge 480 contains an additive 482. Cartridge 480 may be made of any kind of suitable material, such as plastic or metal, and additive 482 may be in liquid or solid form. In the case of solid form, cartridge 480 may itself be a solid block of additive. Cartridge 480 fits into an apertured holder 484 which is sealed by a plug 486. Plug 486 preferably sealingly snap fits into apertured holder 484 and is provided with a threaded neck 488. Below threaded neck 488 is a neck portion 485 formed with a plurality of through holes 487. Holes 487 are in fluid communication with a bore 483 which is in turn in fluid communication with apertured holder 484.

Referring now to Fig. 15, it is seen that threaded neck 488 can be screwed into a container 490 and is preferably sealed by an O-ring 491. Container 490 has a fluid inlet 492 and a fluid outlet 494. Fluid may enter inlet 492, such as from reservoir 30 (Fig. 2) and flow through holes 487 and bore 483 into apertured holder 484. Cartridge 480 becomes submerged in the fluid and additive 482 is mixed with the fluid, such as by seeping, leaching, or dissolving, for example. The fluid with the additive 482 then exits via outlet 494 and flows into vessel 28. Referring now to Fig. 17, it is seen that a carrier 496 may be provided for convenient storage of a plurality of cartridges 480.

Reference is now made to Fig. 18 which illustrates a fluid authorization system 500 for verifying use of an authorized fluid in the windshield wiper cleaning apparatus of Fig. 1, constructed in accordance with a preferred embodiment of the present invention. Fluid authorization system 500 preferably includes a membrane 502 and a viewing window 504 both of which are preferably sealed by a seal 506, such as an O-ring, round or rectangular in shape, for example. Membrane 502 is preferably constructed of a material that disintegrates if it is not in the presence of a fluid authorized for use with the windshield wiper cleaning apparatus of the present invention. For example, additive 482 mixed with water may cause a chemical reaction which inhibits decomposition or disintegration of membrane 502. (One example would be a membrane which is decomposed in the presence of a basic solution and additive 482 changes the pH of the solution to neutral or acidic, thereby preventing the

decomposition of the membrane.) If an authorized fluid is not used, then any disintegration of membrane 502 may be viewed through viewing window 504.

Reference is now made to Figs. 19A and 19B which illustrate a solenoid 510 constructed in accordance with a preferred embodiment of the present invention, and useful in the windshield wiper cleaning apparatus of the present invention. Solenoid 510 preferably comprises a central shaft 512 at a distal end of which is secured a generally inverted U-shaped yoke 514. Electromagnetic apparatus 511 is provided for moving shaft 512 generally linearly. A rod 516 is preferably fixedly pinned to yoke 514 by a pin 518. Attached to a bottom portion of a body 520 of solenoid 510 is a tube receiving member 522. Tube receiving member 522 also preferably includes a pair of fixed rods 532 and 534 which pass through openings 536 and 538, respectively, formed in yoke 514. As seen in Figs. 19A and 19B, a tube 528 is positioned between rod 516 of yoke 514 and fixed rod 532. A tube 530 is positioned between rod 516 of yoke 514 and fixed rod 534. Yoke 514 is disposed in a cavity 540 of tube receiving member 522. Tubes 528 and 530 are preferably made of a resilient material, such as rubber or neoprene. The resilient tubes springing back from the compressed state to the non-compressed state applies a force on shaft 512 and further aids in the generally linear travel of shaft 512, thereby realizing energy savings.

Fig. 19A illustrates a normally open position of solenoid 510. In this position, rod 516 squeezes tube 530, thereby substantially sealing tube 530 from passage therethrough of a fluid. Tube 530 (as well as tube 528) preferably have an elliptical cross section (or other suitable non-circular shape) to facilitate flattening thereof. Synergistically, this shape also enables smaller distances of travel of central shaft 512 and larger forces applied by the solenoid to the tubes. In the normally open position, tube 528 is not squeezed, and fluid may pass therethrough.

Solenoid 510 can be energized to a closed position. In this position, rod 516 is brought upwards in the sense of Figs. 19A and 19B, and now squeezes tube 528, thereby substantially sealing tube 528 from passage therethrough of a fluid. In the closed position, tube 530 is not squeezed, and fluid may pass therethrough. It is also possible to energize solenoid 510 to be in a partially open position wherein fluid can exit both tubes 528 and 530.

It is appreciated by persons skilled in the art that the structure of solenoid 510 may be suitably modified to seal and open just one tube or more than two tubes, if desired. It is also

appreciated that the normally open position and closed positions may be reversed. In addition, the tubes can be connected by suitable connections, such as tee-connections.

Reference is now made to Fig. 20 which illustrates apparatus 600 to prevent damage due to freezing of the fluid in the windshield wiper cleaning apparatus of Fig. 1, constructed in accordance with a preferred embodiment of the present invention. Apparatus 600 preferably includes a movable platform 602 attached to a rod 604 at the bottom of inner and outer chambers 52 and 54 of vessel 28. A biasing device 606, such as a coil spring, is mounted at rod 604 and normally urges platform 602 upwards. Rod 604 is arranged to slide out of vessel 28 through a bore 607. If the fluid in inner or outer chambers 52 and 54 freezes and expands upon freezing, the frozen fluid will expand against platform 602. Platform 602 will compress biasing device 606 and move downwards due to the force of the expanding frozen fluid. In this manner, the expanding frozen fluid does not expand against wall 56 and no damage is caused to wall 56.

Another example of apparatus to prevent damage due to freezing of the fluid is shown in Fig. 23. In this embodiment, a cap 608 is provided at the top of vessel 28. Cap 608 normally seals vessel 28. If the fluid in inner or outer chambers 52 and 54 freezes and expands upon freezing, the frozen fluid will expand against cap 608. Cap 608 is not tightly secured to vessel 28 and can move upwards due to the force of the expanding frozen fluid. In this manner, the expanding frozen fluid simply pushes off cap 608 and expands outwards and upwards, instead of against wall 56, and thus no damage is caused to wall 56.

Reference is now made to Figs. 21 and 22 which illustrate apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage due to overheating, constructed in accordance with a preferred embodiment of the present invention. In this embodiment, a fuse 610 is provided electrically connected to heating element 50. Fuse 610 includes a portion 612 exposed to the fluid in vessel 28. Upon reaching a predetermined critical temperature, above which possible damage can occur to components of the windshield wiper cleaning apparatus, fuse 610 causes a break in the electrical supply to heating element 50, and thereby prevents possible damage due to overheating. Fuse 610 is thus a protection element which is internal to vessel 28 and which is in contact with the fluid of vessel 28.

Reference is now made to Fig. 23 which illustrates apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage

due to overheating, constructed in accordance with another preferred embodiment of the present invention. In this embodiment, a fuse 614 is provided electrically connected to heating element 50. Fuse 614 includes a body 616 to which is soldered a cap portion 618 at a soldered connection 619. Cap portion 618 is biased by a biasing device 620, such as a coil spring. The electrical connection of fuse 614 to heating element 50 is through soldered connection 619.

Fuse 614 is exposed to the fluid in vessel 28. Upon reaching a predetermined critical temperature, above which possible damage can occur to components of the windshield wiper cleaning apparatus, soldered connection 619 becomes weakened due to partial or complete melting of the solder, and biasing device 620 urges cap portion 618 upwards and off body 616, thereby causing a break in the electrical supply to heating element 50, and thus preventing possible damage due to overheating. Fuse 614 is also a protection element which is internal to vessel 28 and which is in contact with the fluid of vessel 28.

Fuse 614 is preferably mounted on a base 622 which is sealed with respect to vessel 28 by means of an O-ring 624. An endcap 626 screws onto the bottom of vessel 28 and has a long central tongue 628 which presses base 622 against O-ring 624, thereby forming the sealed connection with respect to vessel 28.

Reference is now made to Fig. 24 which illustrates apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage due to overheating, constructed in accordance with yet another preferred embodiment of the present invention. In this embodiment, a fuse 630 is provided which is physically internal to and electrically connected to heating element 50. Heating element 50 comprises a resistance wire 631 connected to ground 633 through an electrically conductive cover sleeve 635. Fuse 630 may be a soldered point, for example. Upon reaching a predetermined critical temperature, above which possible damage can occur to components of the windshield wiper cleaning apparatus, fuse 630 causes a break in the electrical supply to heating element 50, and thereby prevents possible damage due to overheating.

Reference is now made to Fig. 25 which illustrates apparatus for shutting off electrical supply the windshield wiper cleaning apparatus of Fig. 1, in order to prevent possible damage due to overheating, constructed in accordance with still another preferred embodiment of the present invention. In this embodiment, a FET (field effect transistor) 632 is in electrical communication with controller 46, and comprises part of the control circuitry used to control operation of apparatus 20 as described hereinabove. FET 632 receives a command voltage

signal from controller 46. FET 632 is connected to heating element 50, and of course, battery 42. A voltage sensor 633 is provided for sensing the voltage drop across contacts A and B of FET 632. A fuse 634 is provided external to vessel 28. Upon reaching a predetermined critical temperature, above which possible damage can occur to components of the windshield wiper cleaning apparatus, fuse 630 causes a break in the electrical supply to heating element 50, and thereby prevents possible damage due to overheating.

Another FET 636 is preferably connected in parallel to FET 632 and heating element 50. FET 636 receives a command voltage signal from one of three sources:

1. Any of the temperature sensors associated with vessel 28, such as sensors 301 and 302, for example.

2. A thermostat 638 mounted in vessel 28 (Fig. 23) and dedicated to sending a command signal to FET 636.

3. Logic circuitry 640 which can send a command signal to FET 636.

The command signals are preferably sent to FET 636 via an interface circuit 642.

The operation of the apparatus of Fig. 25 is now explained. If no command signal is sent to FET 632 from controller 46, FET 632 is open and a voltage drop, such as 12 V, for example, exists across contacts A and B of FET 632. This is a normal condition wherein heating element 50 is not energized.

If a command signal is sent to FET 632 from controller 46, such as a 5 V signal, for example, FET 632 is closed and the voltage drop across contacts A and B of FET 632 is near zero. This is a normal condition wherein heating element 50 is energized and heats up.

If, however, no command signal is sent to FET 632 from controller 46, but voltage sensor 633 senses a near zero voltage drop across A and B, then a malfunction has occurred. The near zero voltage drop sensed by voltage sensor 633 is communicated to logic circuitry 640 which commands FET 636 to close, thereby sending a high current through fuse 634 which breaks fuse 634 and disconnects the supply of electricity to heating element 50. Thus the malfunction is prevented from causing overheating of the system.

If, however, a command signal is sent to FET 632 from controller 46, but voltage sensor 633 senses a voltage drop across A and B, such as the abovementioned 12 V, for example, then another type of malfunction has occurred. This kind of malfunction is not dangerous because FET 632 is open (as sensed by the presence of the 12 V voltage drop), and

heating element 50 will not be energized. Nevertheless, since the system has detected a malfunction, logic circuitry 640 can still command the system to shut down, if desired.

Reference is now made to Figs. 26-29 which illustrate a solenoid 650 useful in the windshield wiper cleaning apparatus of Fig. 1, constructed in accordance with another preferred embodiment of the present invention. Solenoid 650 preferably includes a coil 652 in electrical communication with a control circuit printed circuit board (PCB) 654. Unlike other solenoids which are separately built items and electrically connected to the windshield wiper cleaning apparatus, solenoid 650 is characterized by being directly electrically connected to PCB 654, such as by means of hard wiring or electrical contacts which connect the electrical components of solenoid 650, e.g., coil 652, to PCB 654. Solenoid 650 is preferably attached to PCB 654 by any suitable method, such as by means of mechanical fasteners, soldering, bonding, etc. Solenoid 650 also includes an inlet 656 and a pair of outlets 658 and 660. Outlet 658 is fluidly connected to the spray heads, whereas outlet 658 is fluidly connected to vessel 28. Solenoid 650 has a plunger 662 for directing the fluid flow through solenoid 650.

In Figs. 26 and 27, plunger 662 is positioned somewhat away from the inlet end of solenoid 650, thereby opening a passageway 668 and directing the flow of a fluid to outlet 658. In Figs. 28 and 29, plunger 662 has been moved towards the inlet end of solenoid 650, thereby substantially sealing passageway 668 and directing the flow of a fluid to outlet 660.

Solenoid 650 is normally controlled by control signals received from local control circuitry 664 of PCB 654. Control circuitry 664 controls the functions of the pump, heating element, high voltage supply, etc. Another portion of PCB 654, circuitry 666, controls functions which are normally controlled by the vehicle computer. Normally the operation of solenoid 650 is controlled by the circuitries 664 and 666. Alternatively, circuitry 666 may be connected to the vehicle computer, such as by means of optical links, hardwire, switching, etc., in which case the operation of solenoid 650 is controlled by the circuit 664 and the vehicle computer.

It will be appreciated that the preferred embodiments described above are cited by way of example, and the full scope of the invention is limited only by the claims.

CLAIMS

What is claimed is:

1. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window; and

a first heating element disposed in the vessel for heating the fluid in the vessel;

characterized by

an auxiliary heating element being disposed in the vessel for heating the fluid in the vessel, wherein said auxiliary heating element is disposed at a bottom portion of the vessel and is operative to heat a quantity of fluid which is not necessarily sufficient to cover the first heating element.

2. Apparatus according to claim 1 and further comprising a plurality of sensors which feed data concerning at least one of a temperature and a fluid level of the fluid in the vessel to a controller, said controller controlling energization of the first and auxiliary heating elements in response to the data.

3. Apparatus according to claim 1 and further comprising a temperature sensor mounted in said auxiliary heating element.

4. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged;

a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle window; and

a heating element disposed in the vessel for heating the fluid in said vessel;

characterized by

a temperature sensor mounted in propinquity to said spray head, said temperature sensor being in communication with a controller which controls heating of said heating element in response to a temperature sensed by said temperature sensor.

5. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged;

a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle window; and

a heating element disposed in the vessel for heating the fluid in said vessel;

characterized by

a wind speed sensor in communication with a controller, wherein said controller correlates a wind speed sensed by said wind speed sensor to a temperature of the fluid sprayed from the spray head, and controls heating of said heating element in response to the wind speed sensed by said wind speed sensor.

6. Apparatus according to claim 5 and further comprising a vehicle speed sensor, wherein said controller also correlates a vehicle speed sensed by said vehicle speed sensor to a temperature of the fluid sprayed from the spray head, and controls heating of said heating element in response to the vehicle speed sensed by said vehicle speed sensor.

7. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window; and

a first heating element disposed in the vessel for heating the fluid in the vessel;

characterized by

a pumping system in fluid communication with said reservoir and said vessel which selectively pumps fluid from said reservoir to said vessel and drains said fluid from said vessel back to said reservoir.

8. Apparatus according to claim 7 and wherein said pumping system comprises at least one solenoid in fluid communication with said reservoir and said vessel and switchable from a first position to a second position, wherein in said first position said at least one solenoid permits flow from said reservoir to said vessel and substantially prevents draining said fluid from said vessel back to said reservoir, and wherein in said second position said at least one solenoid permits draining said fluid from said vessel back to said reservoir and substantially prevents flow from said reservoir to said vessel.

9. Apparatus according to claim 7 and wherein said pumping system comprises a reversible pump which in a first operating orientation pumps said fluid from said reservoir to

said vessel and in a second operating orientation pumps said fluid from said vessel back to said reservoir.

10. Apparatus according to claim 9 and wherein said reversible pump comprises a geared pump.

11. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged;

a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle window;

a windshield wiper for wiping said window; and

characterized by

said spray head comprising a multi-outlet spray head that comprises a plurality of spray outlets.

12. Apparatus according to claim 11 and further comprising a controller which controls a spraying pattern of said plurality of outlets.

13. Apparatus according to claim 12 and further comprising a sensor for sensing an angular position of said windshield wiper, wherein said controller controls the spraying pattern of said plurality of outlets in accordance with the angular position of said windshield wiper.

14. Apparatus according to claim 11 and further comprising a cam mounted on the windshield wiper said cam selectively opening said outlets to permit flow of said fluid therethrough.

15. Apparatus according to claim 12 and further comprising a motor which actuates the windshield wiper and a sensor for sensing a torque of said motor, wherein said controller controls the spraying pattern of said plurality of outlets in accordance with the torque of said motor.

16. Apparatus according to claim 11, wherein said windshield wiper wipes said window between two limits of travel, and said windshield wiper is placeable in a summer parking mode and a winter parking mode, wherein in said summer parking mode, said wiper is at rest generally at one of the limits of travel, and wherein in said winter parking mode, said wiper is between said limits of travel.

17. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged;

a spray head in fluid communication with the outlet through which the fluid is sprayed onto a vehicle window;

a windshield wiper for wiping said window; and

characterized by

said windshield wiper having a longitudinal bore formed therethrough for flow of the fluid therethrough, wherein said bore fluidly communicates with a plurality of outlet holes formed in said wiper for applying the fluid on said window.

18. Apparatus according to claim 17 and wherein the fluid enters said bore at one end of said wiper and an opposite end of said wiper is substantially sealed.

19. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window; and

characterized by

further comprising a cartridge which dispenses an additive to the fluid prior to discharging the fluid.

20. Apparatus according to claim 19 and wherein said cartridge comprises a solid block of said additive.

21. Apparatus according to claim 19 and wherein said cartridge fits into an apertured holder which is sealed by a plug, said plug comprising a threaded neck and a neck portion formed with a plurality of through holes, said holes being in fluid communication with a bore which is in turn in fluid communication with said apertured holder, and wherein said threaded neck can be screwed into a container through which the fluid can flow into the vessel, wherein the additive is mixed with the fluid as the fluid flows through said container.

22. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window; and

characterized by

further comprising a fluid authorization system for verifying use of an authorized fluid.

23. Apparatus according to claim 22 and wherein said fluid authorization system comprises a membrane constructed of a material that disintegrates if it is not in the presence of a fluid authorized for use.

24. Apparatus for cleaning or de-icing a vehicle window, comprising:

a reservoir for containing therein a washing fluid;

a vessel having an inlet through which the washing fluid is received from the reservoir and an outlet through which the fluid is discharged for cleaning a vehicle window; and

characterized by

further comprising at least one tube in fluid communication with the fluid and a solenoid which selectively squeezes and seals said at least one tube to prevent passage of the fluid therethrough and selectively permits flow of the fluid therethrough.

25. A solenoid comprising:

a tube receiving member;

at least one tube which passes through said tube receiving member;

a shaft arranged for generally linear movement relative to said tube receiving member, said shaft selectively squeezing and sealing said at least one tube against said tube receiving member to prevent passage of the fluid therethrough, and selectively moving away from said at least one tube to permit flow of the fluid therethrough; and

electromagnetic apparatus which moves said shaft generally linearly.

26. The solenoid according to claim 25, wherein said at least one tube has a circular cross section.

27. The solenoid according to claim 25, wherein said at least one tube has a non-circular cross section.

28. The solenoid according to claim 25 and comprising two said tubes and wherein said electromagnetic apparatus moves said shaft to a position so that fluid can pass through both said tubes.

29. The solenoid according to claim 25, wherein said at least one tube has a resiliency such that when said at least one tube returns from a compressed state to a non-compressed

state, said at least one tube applies a force on said shaft to aid in the generally linear movement of said shaft.

30. Apparatus according to claim 4 further comprising apparatus to prevent damage due to freezing of the fluid.

31. Apparatus according to claim 30 wherein said apparatus to prevent damage comprises a platform arranged for sliding in said vessel, said platform being operative to slide due to a force of said fluid pressing thereagainst during freezing of said fluid.

32. Apparatus according to claim 30 wherein said apparatus to prevent damage comprises a cap attached to said vessel and which is operative to move away from said vessel due to a force of said fluid pressing thereagainst during freezing of said fluid.

33. Apparatus according to claim 4 further comprising apparatus for shutting off electrical supply to said heating element.

34. Apparatus according to claim 33 wherein said apparatus for shutting off electrical supply comprises a fuse electrically connected to said heating element.

35. Apparatus according to claim 34 wherein said fuse is internal to said vessel and is in contact with said washing fluid in said vessel.

36. Apparatus according to claim 34 wherein said fuse comprises a body to which is soldered a cap portion at a soldered connection, said cap portion being biased by a biasing device, said fuse being electrically connected to said heating element through said soldered connection, wherein upon reaching a predetermined temperature, said soldered connection becomes weakened due to at least partial melting thereof, and said biasing device urges said cap portion off said body, thereby causing a break in electrical supply to said heating element.

37. Apparatus according to claim 34 wherein said fuse is mounted on a base which is sealed with respect to said vessel by means of an endcap which presses said base against an O-ring mounted on said vessel.

38. Apparatus according to claim 33 wherein said apparatus for shutting off electrical supply comprises a fuse which is physically internal to and electrically connected to said heating element.

39. Apparatus according to claim 33 wherein said apparatus for shutting off electrical supply comprises a first FET in electrical communication with said controller, a fuse external to said vessel and operatively connected to said first FET, a second FET operatively connected to said fuse, said second FET in communication with at least one of said

temperature sensor, a thermostat mounted in said vessel, and logic circuitry in electrical communication with said second FET.

40. Apparatus according to claim 39 wherein if no command signal is sent to said first FET from said controller, said first FET is open and said heating element is not energized.

41. Apparatus according to claim 39 wherein if a command signal is sent to said first FET from said controller, said first FET is closed and said heating element is energized.

42. Apparatus according to claim 39 wherein if no command signal is sent to said first FET from said controller, but a near zero voltage drop exists across said first FET, then said second FET is commanded to close, thereby sending a current through said fuse which breaks said fuse and disconnects electrical supply to said heating element.

43. Apparatus according to claim 39 wherein if a command signal is sent to said first FET from said controller, but a voltage drop generally greater than zero exists across said first FET, then said apparatus for cleaning or de-icing a vehicle window is commanded to shut down.

44. Apparatus according to claim 4 and further comprising a solenoid in direct electrical communication with a control circuit printed circuit board (PCB) mounted in said vessel, said solenoid determining whether said fluid flows directly to said spray head or flows to said spray head via said vessel.

45. Apparatus according to claim 44 wherein said solenoid is attached to said PCB.

46. Apparatus according to claim 44 wherein said PCB is selectively connectable to a vehicle computer, wherein operation of said solenoid and said apparatus for cleaning or de-icing a vehicle window is controllable by at least one of said PCB and said vehicle computer.

47. Apparatus according to claim 7 wherein said pumping system comprises a third operating orientation wherein said pumping system is stopped while the fluid is still flowing towards said vessel, and only after a delay, the fluid is re-routed from a direction towards said vessel to a direction away from said vessel.

FIG. 1

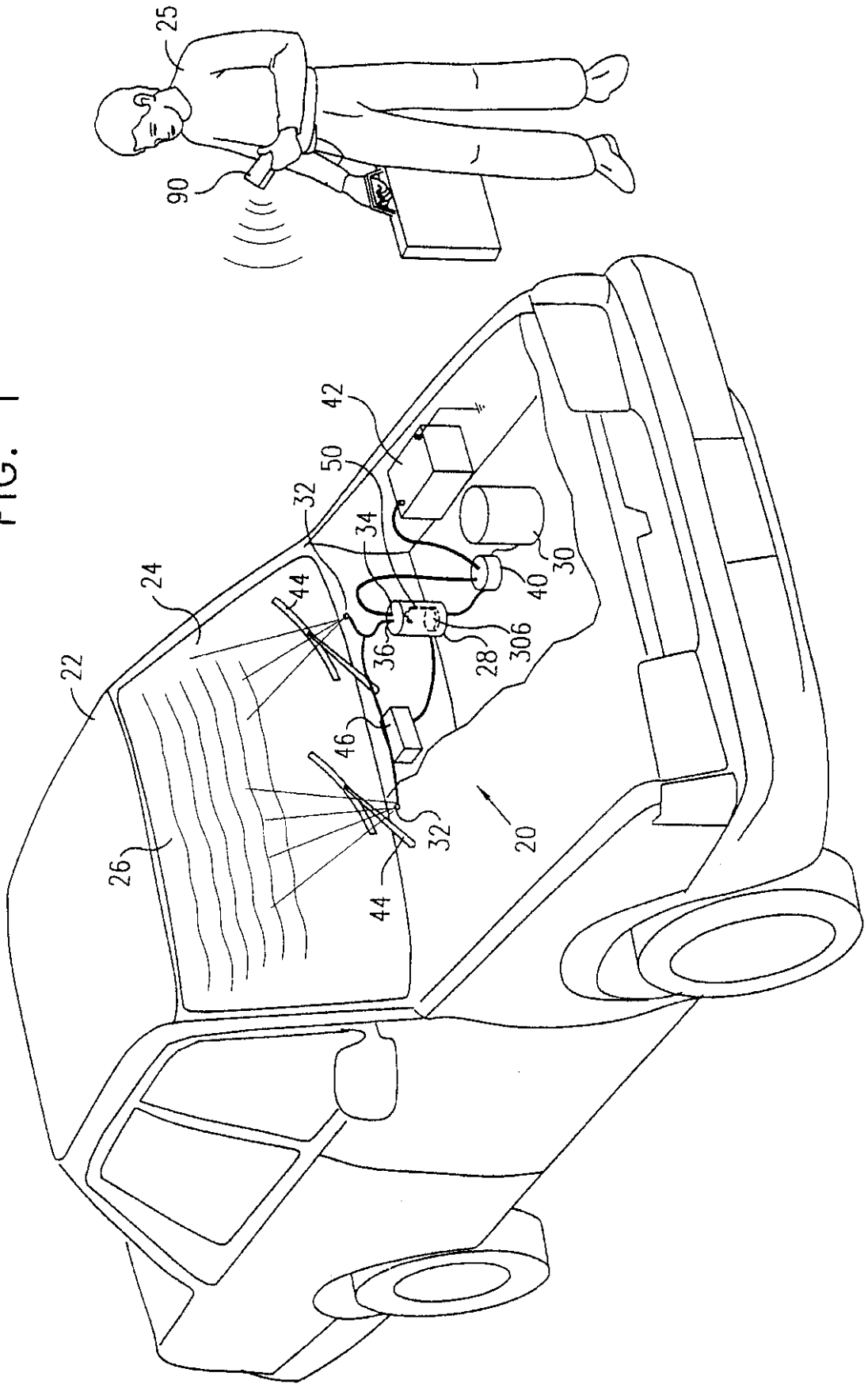
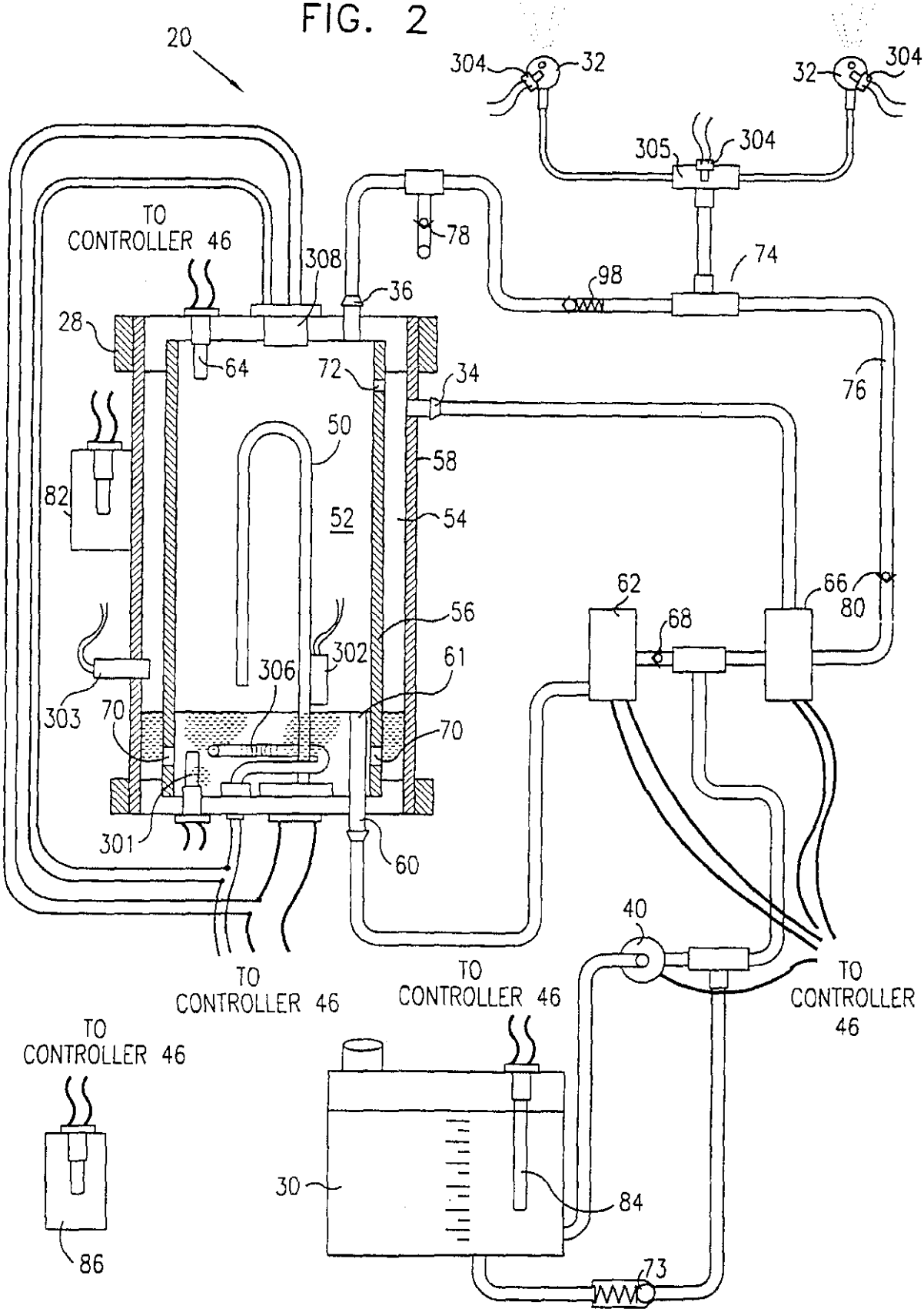


FIG. 2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304
32
32
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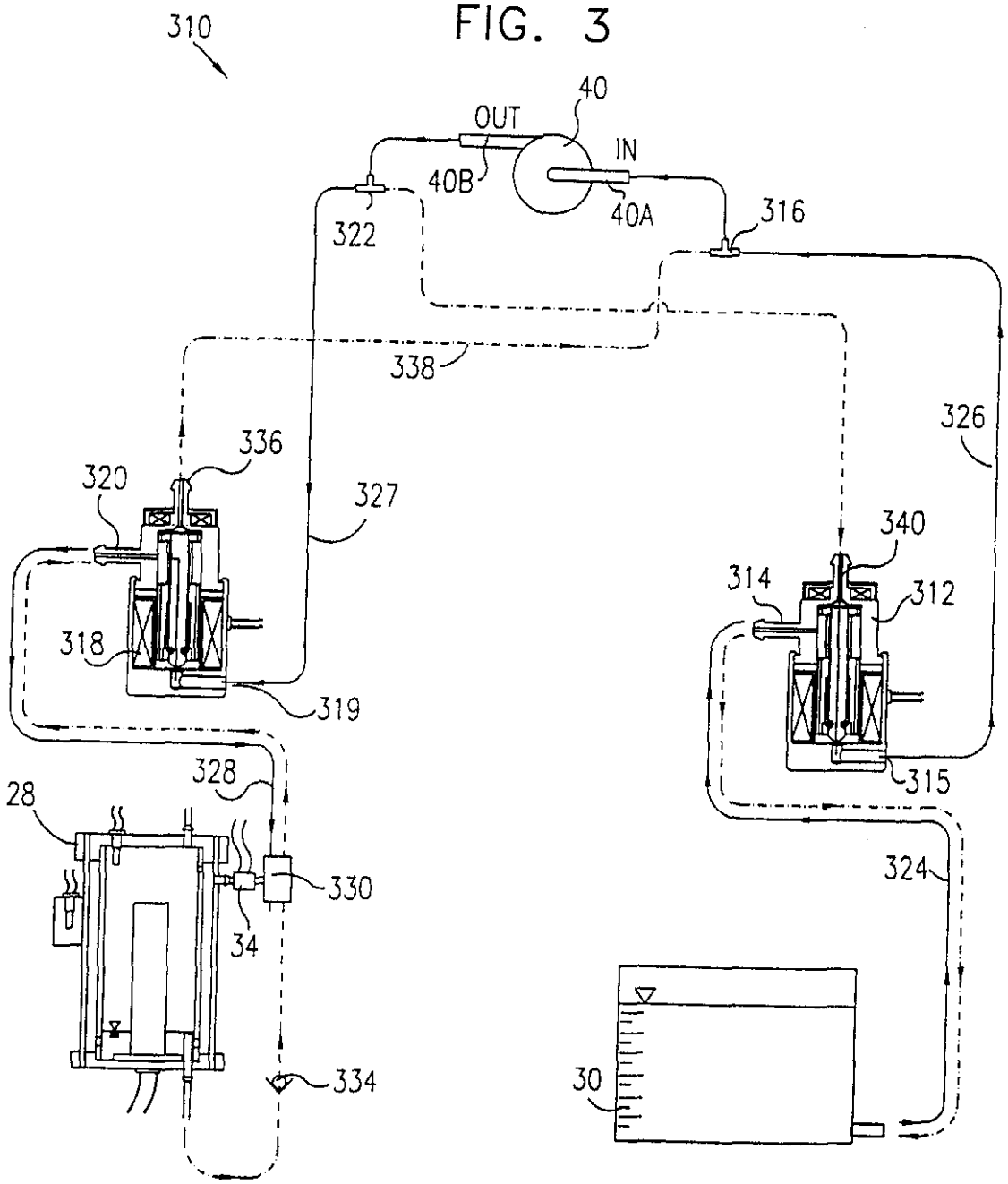
305
304
TO CONTROLLER 46
78
74
308
36
98
28
64
72
34
76
50
58
82
52
54
62
66
80
68
56
302
61
306
303
70
70
301
60
40
TO CONTROLLER 46
TO CONTROLLER 46
TO CONTROLLER 46
TO CONTROLLER 46
30
84
73
86

FIG. 3


310
40
OUT
IN
40B
40A
322
316
338
326
336
320
327
340
314
312
318
319
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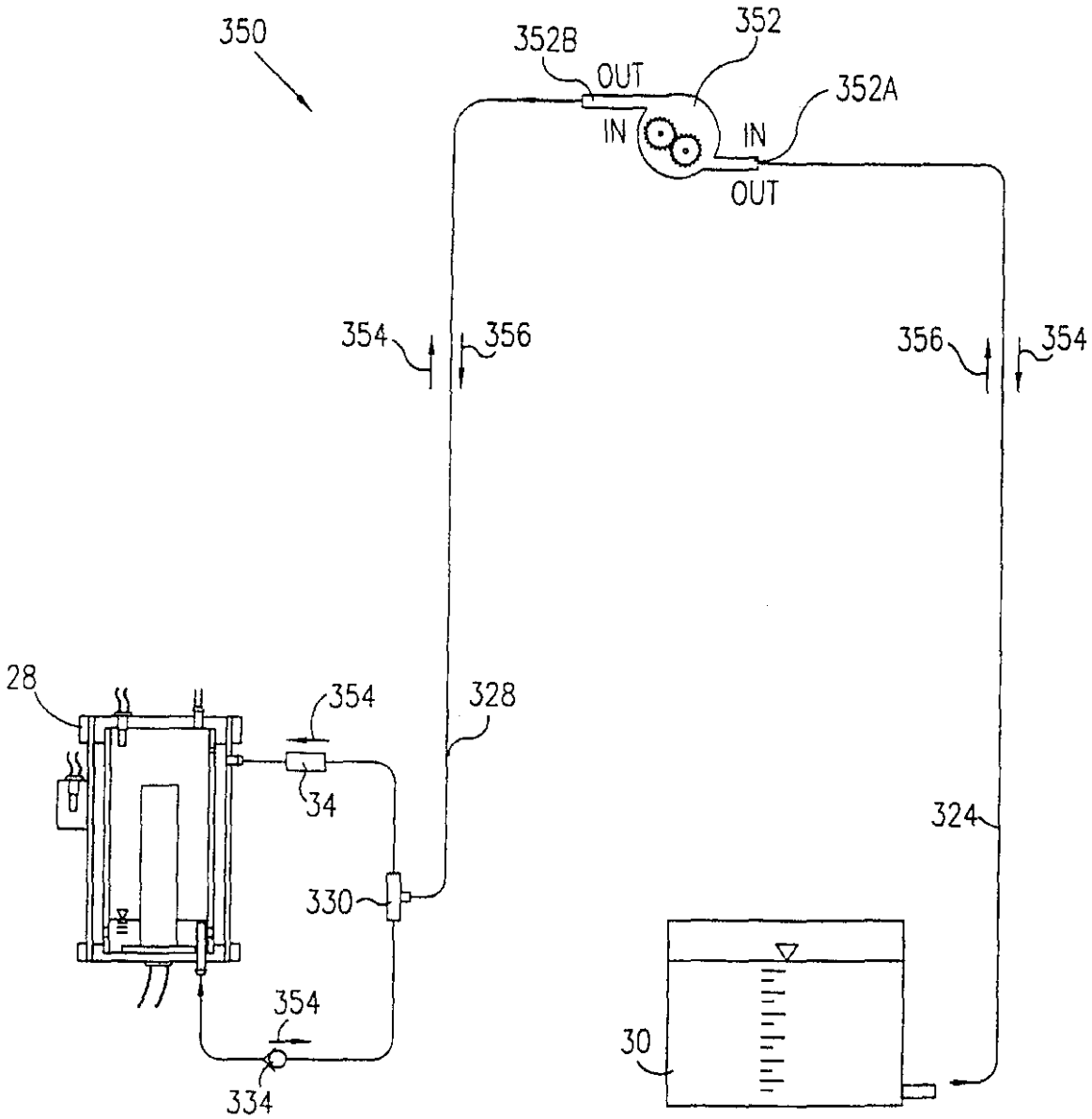
328
28
330
324
34
334
30

FIG. 4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352B
352
OUT
352A
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IN
OUT
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356
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354
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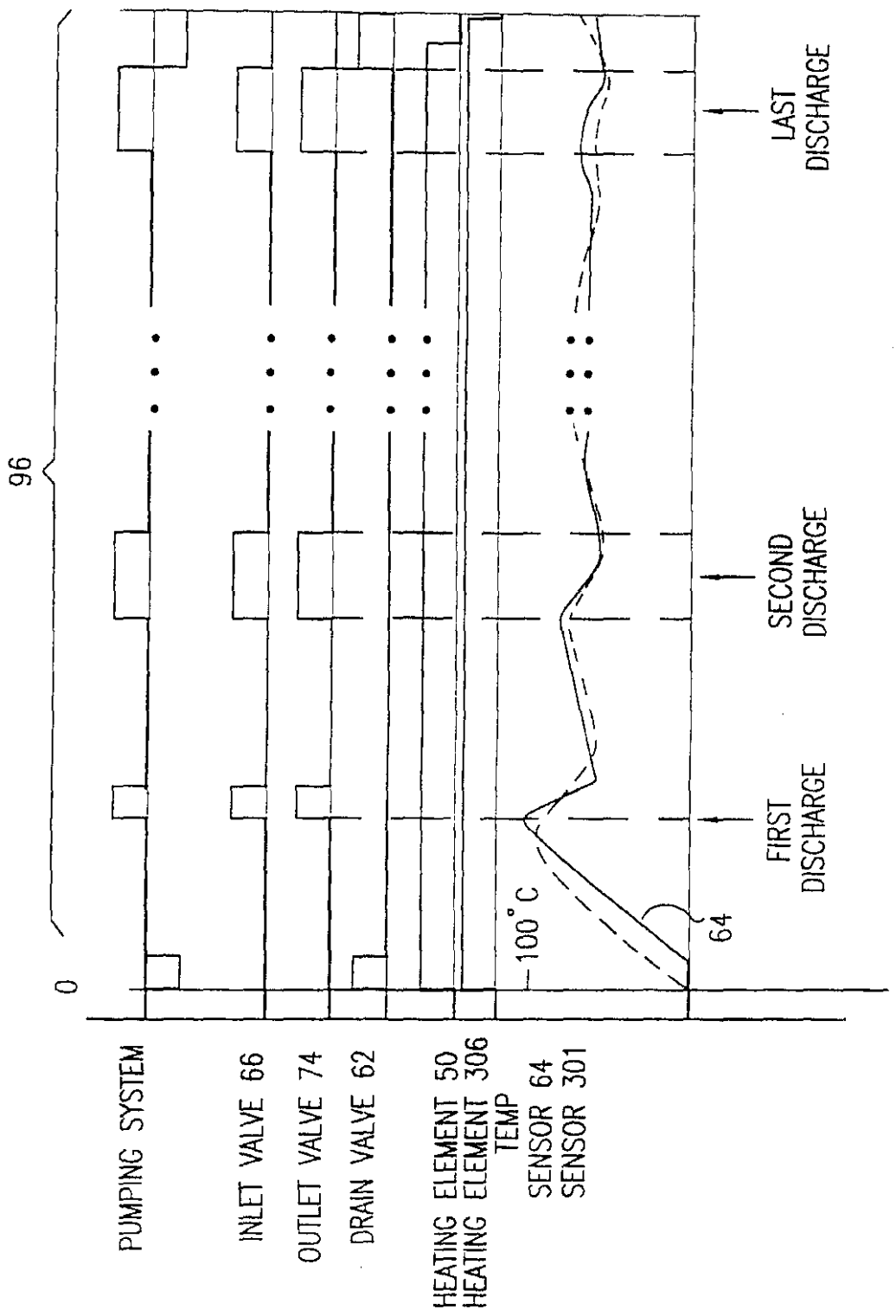
324
354
30
334

FIG. 5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0
PUMPING SYSTEM
INLET VALVE 66
OUTLET VALVE 74
DRAIN VALVE 62
HEATING ELEMENT 50
HEATING ELEMENT 306
TEMP SENSOR 64
SENSOR 301
100°C
64
FIRST DISCHARGE
SECOND DISCHARGE
LAST DISCHARGE

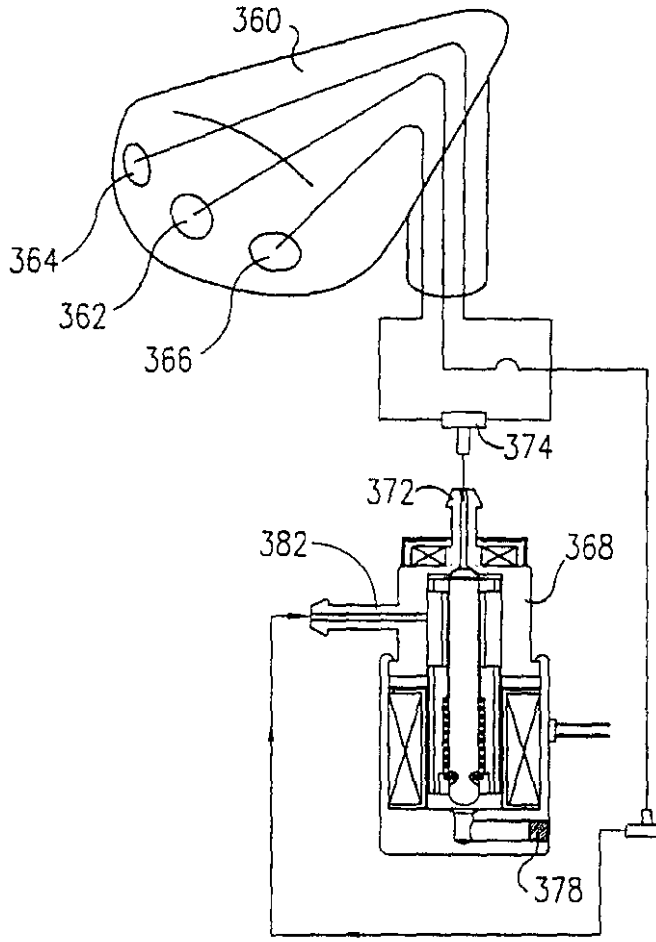

360
364
362
366
374
372
382
368
FROM PRESSURE SOURCE
378

FIG. 6

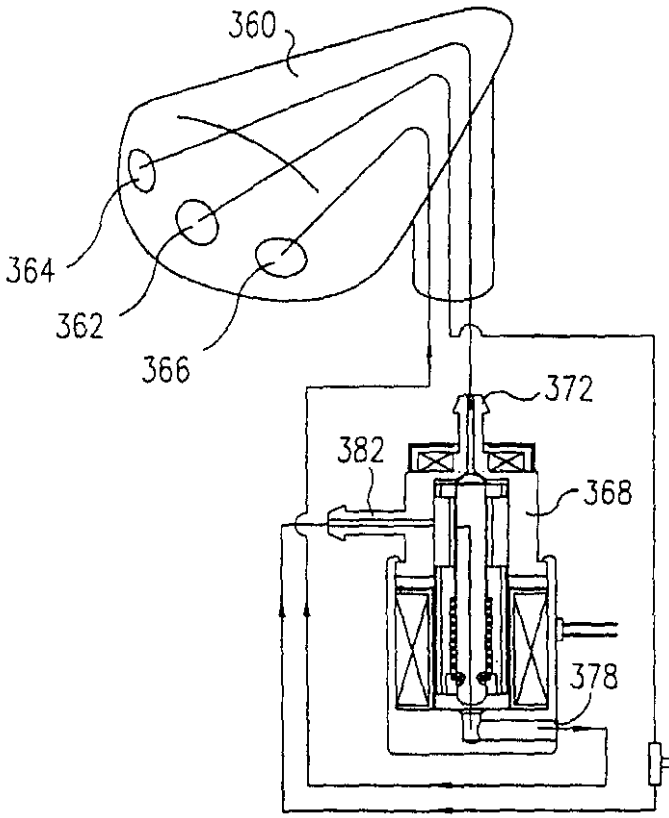
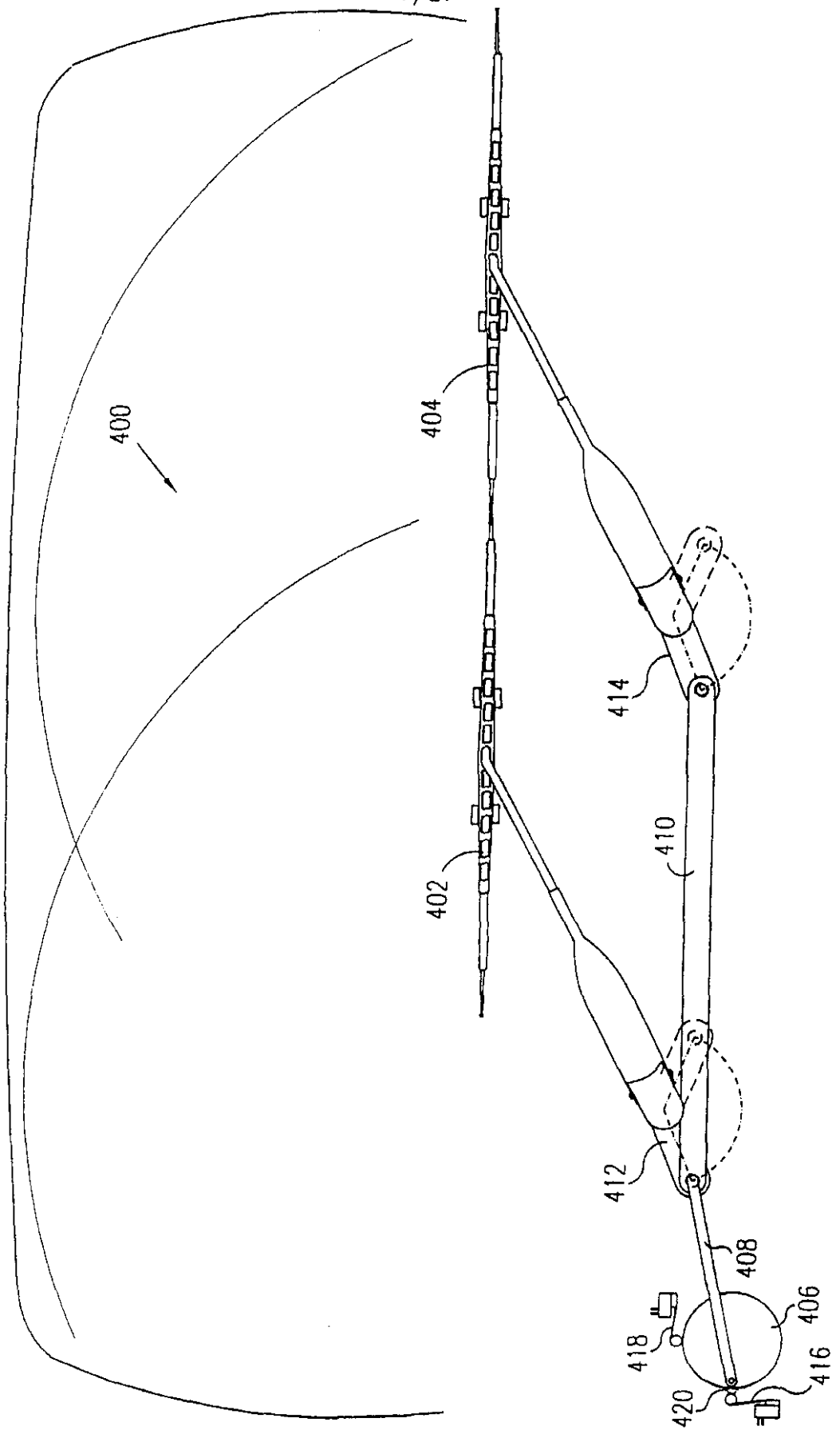

360
364
362
366
372
382
368
378
FROM PRESSURE SOURCE

FIG. 7

FIG. 8



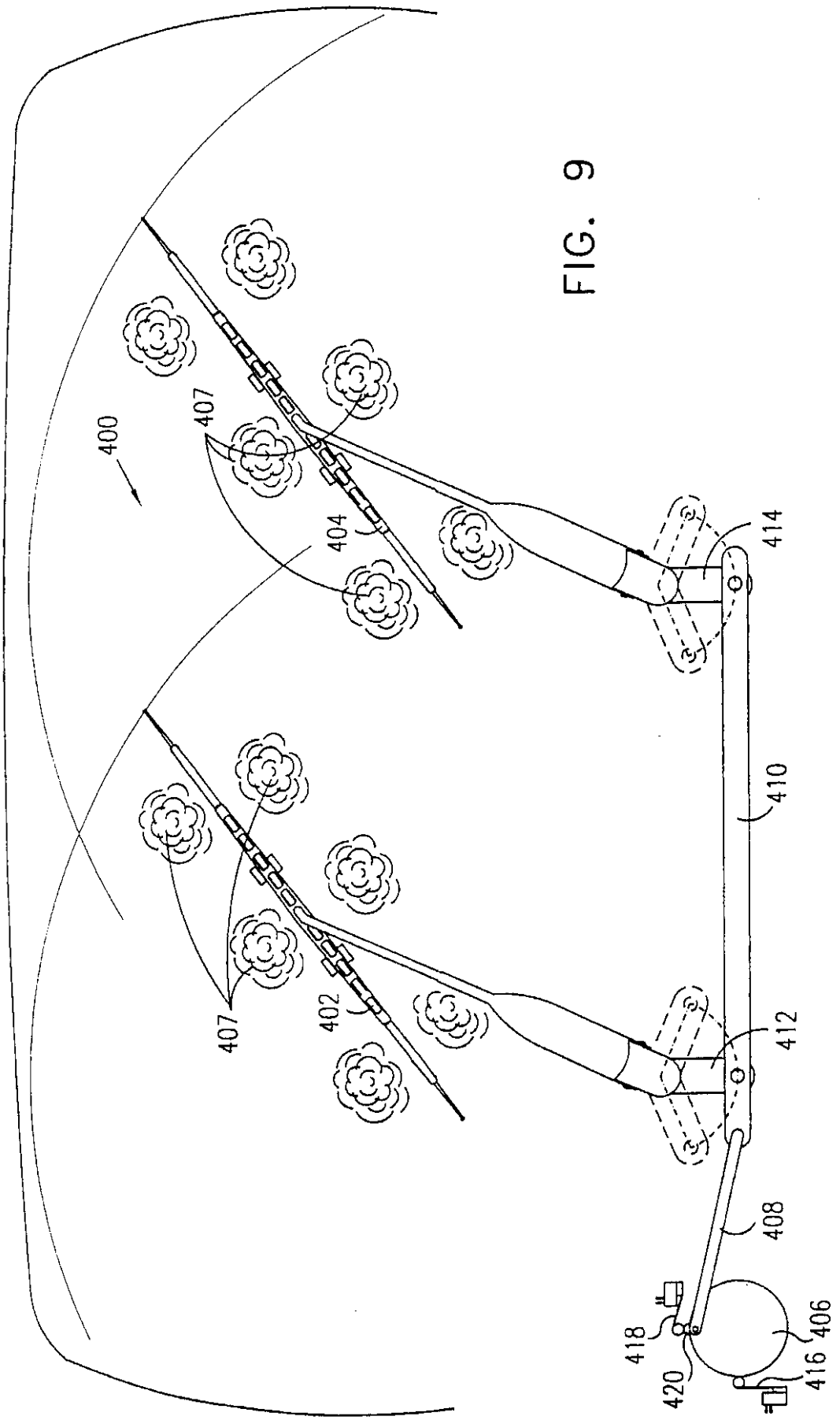


FIG. 9

FIG. 10

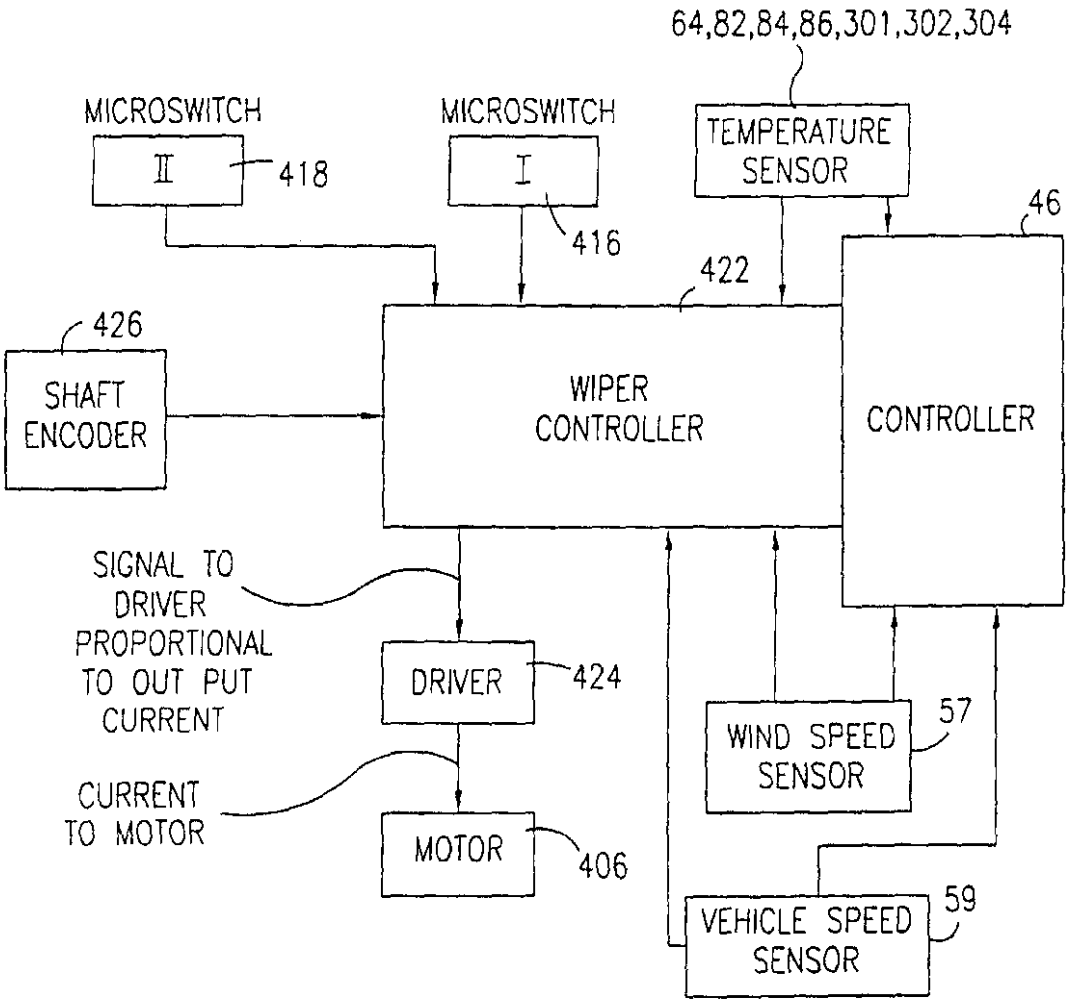

64,82,84,86,301,302,304
MICROSWITCH
II
418
MICROSWITCH
I
416
TEMPERATURE SENSOR
46
422
426
SHAFT ENCODER
WIPER CONTROLLER
CONTROLLER
SIGNAL TO DRIVER PROPORTIONAL TO OUT PUT CURRENT
DRIVER
424
WIND SPEED SENSOR
57
CURRENT TO MOTOR
MOTOR
406
VEHICLE SPEED SENSOR
59

FIG. 11A

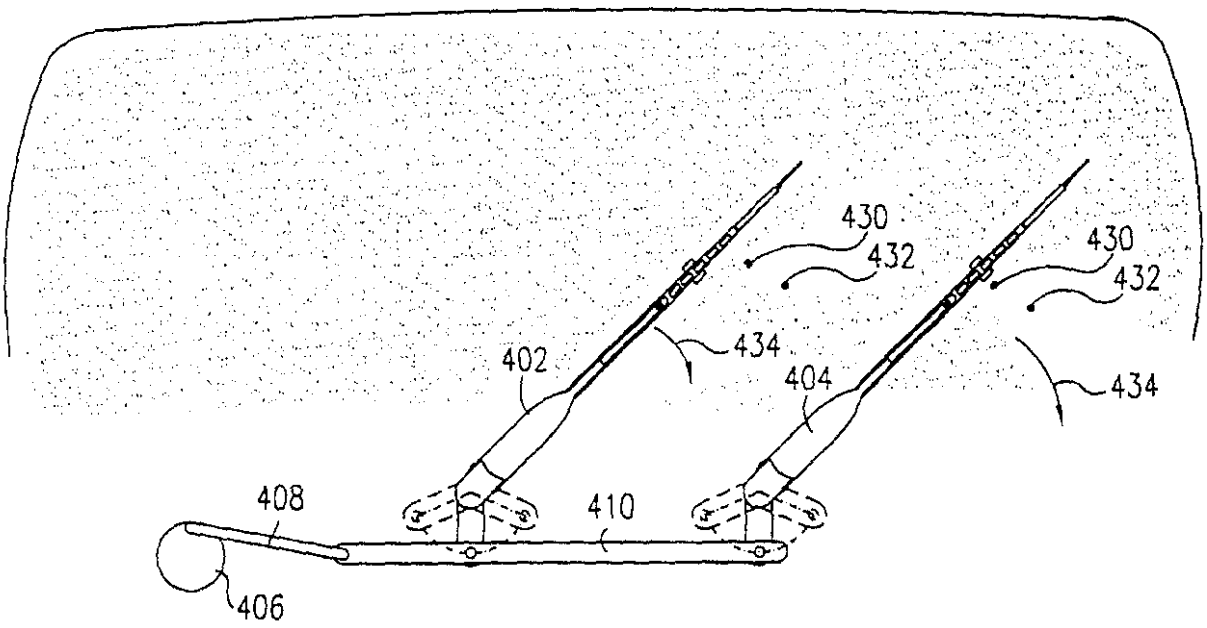


FIG. 11B

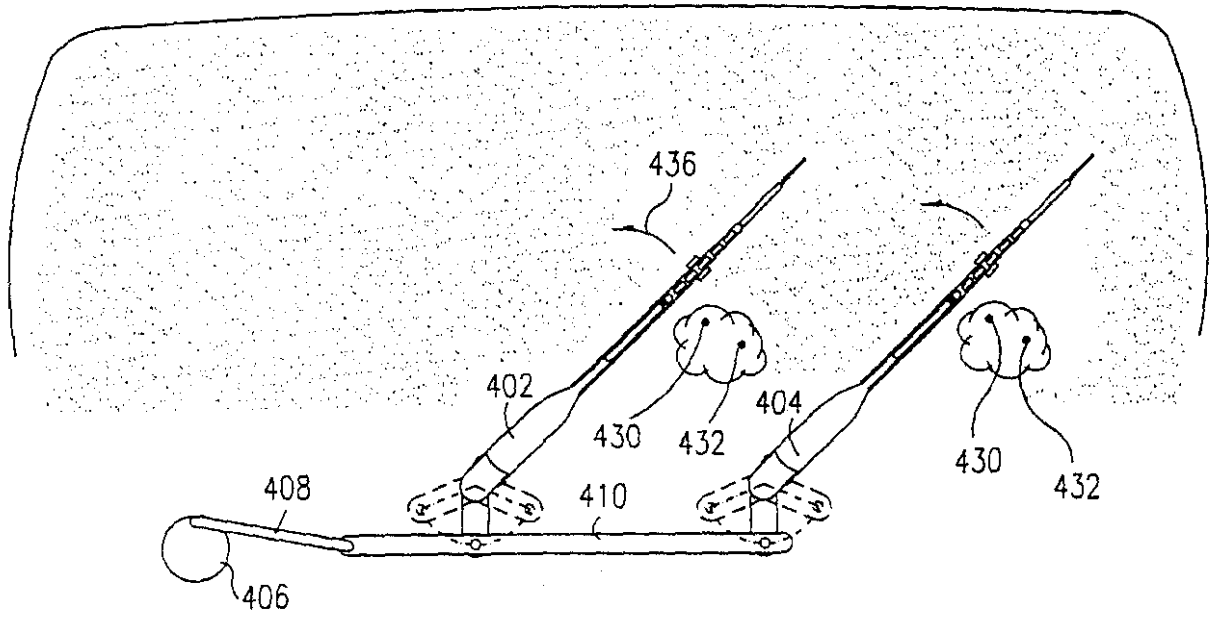


FIG. 11C

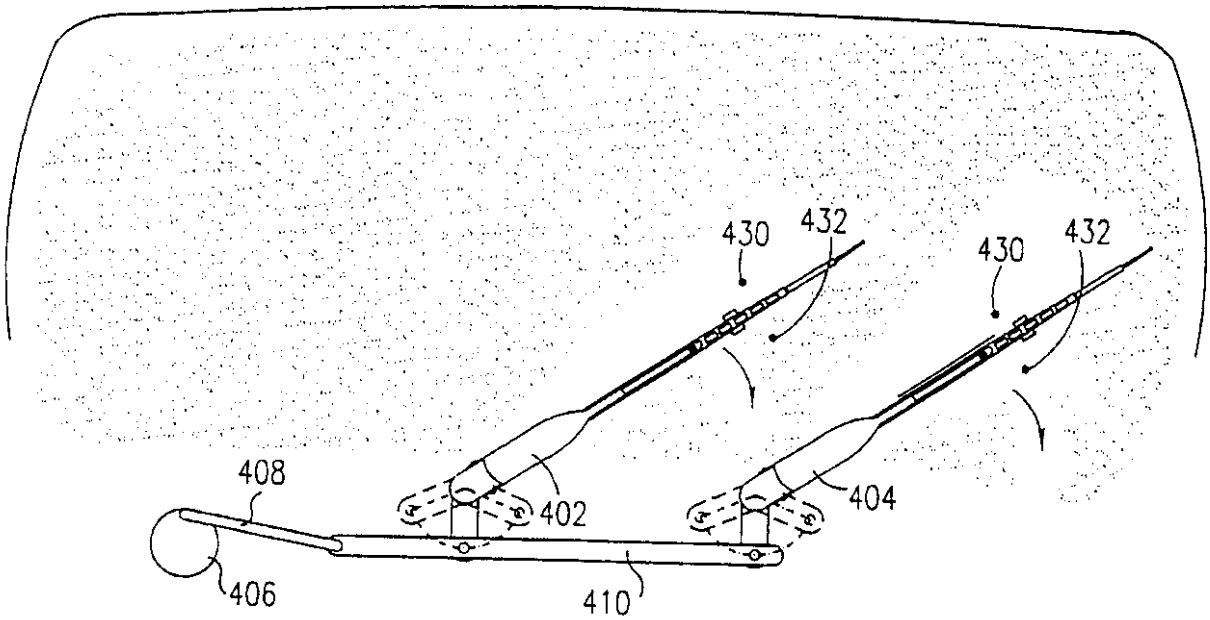


FIG. 11D

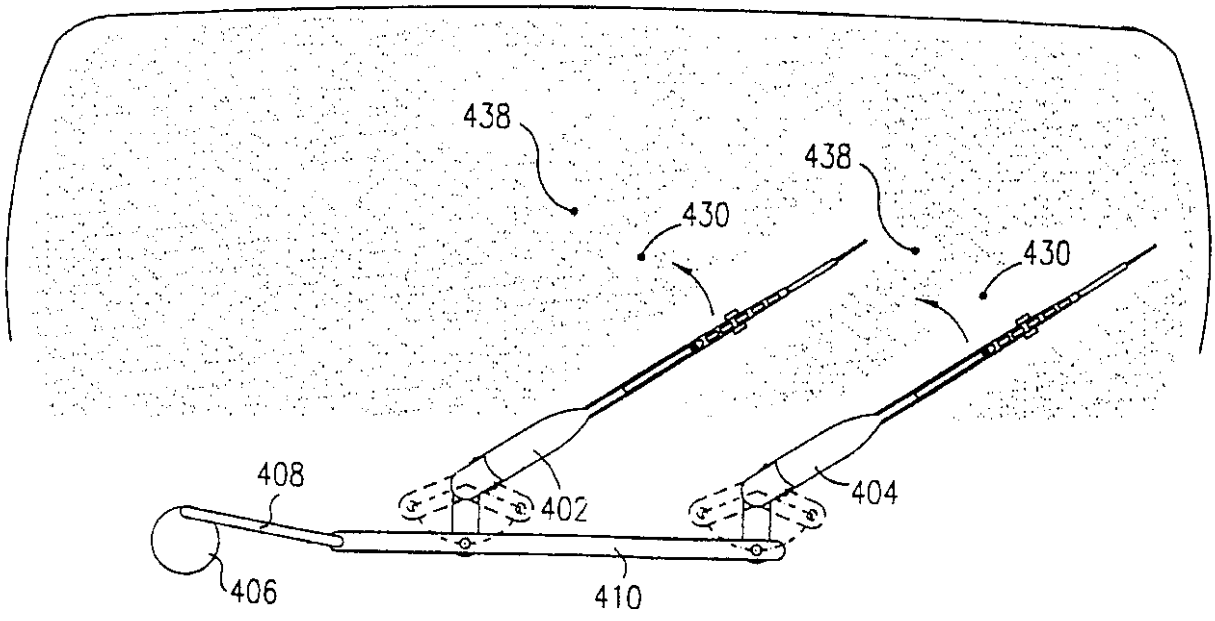


FIG. 11E

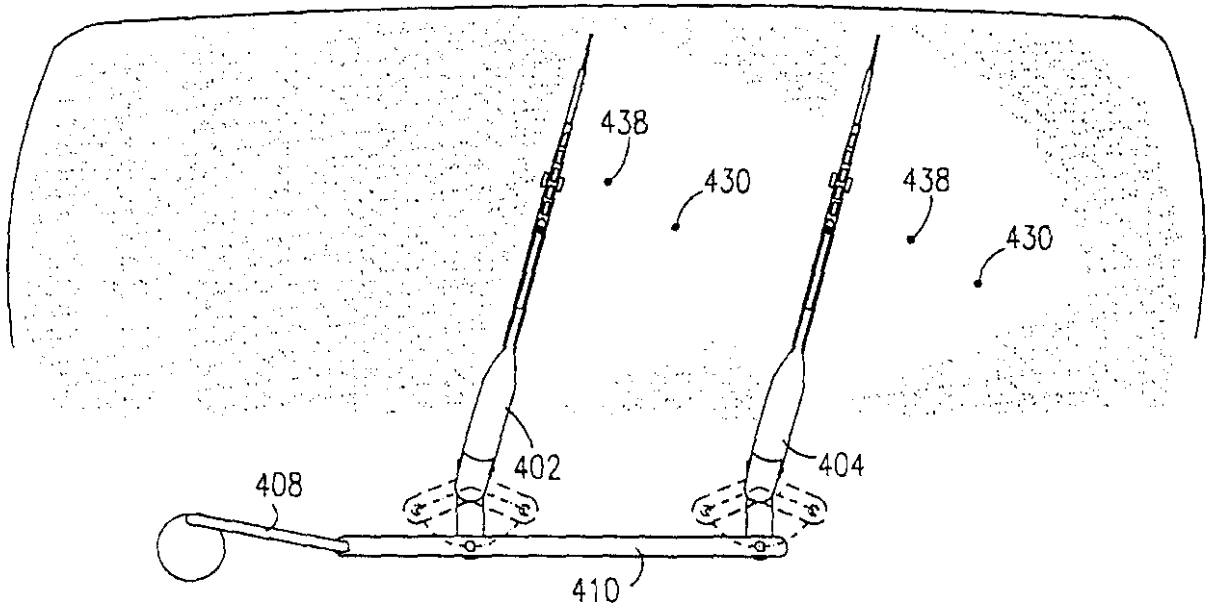
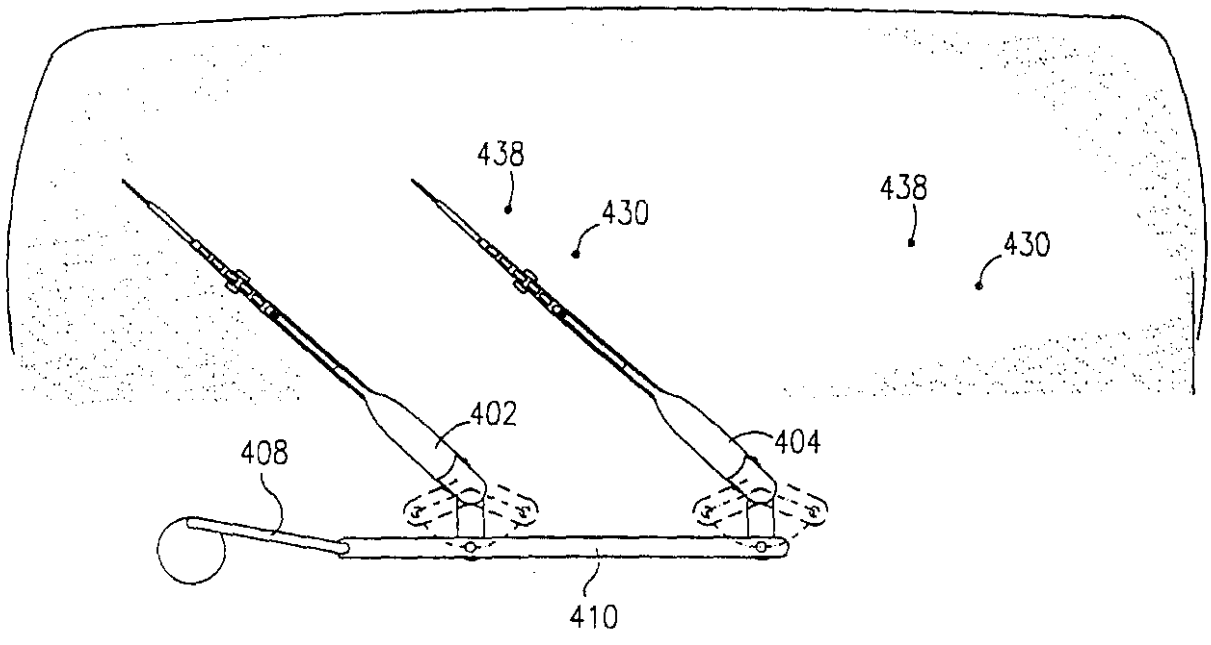
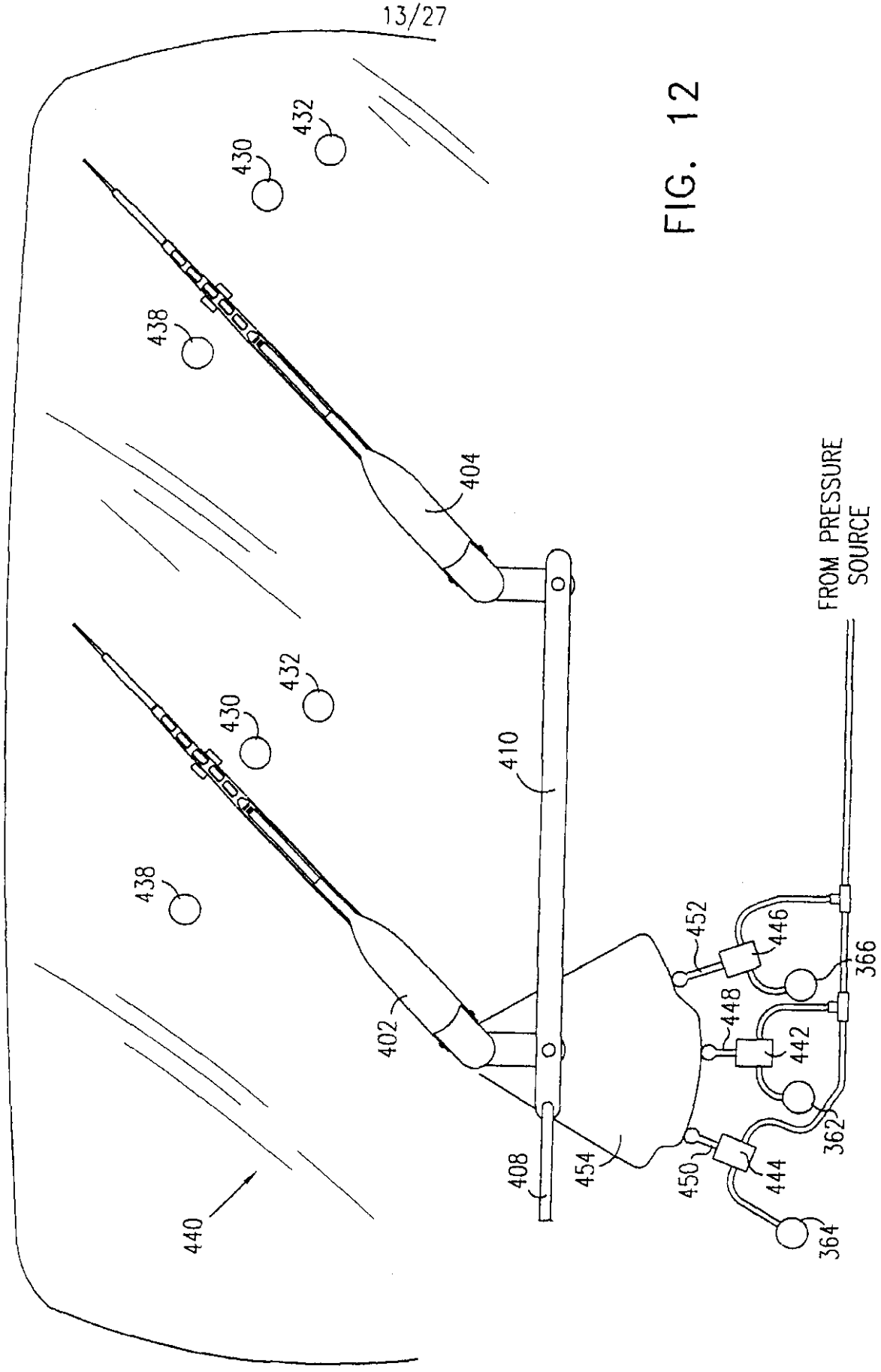


FIG. 11F

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FROM PRESSURE SOURCE

FIG. 12

FIG. 13

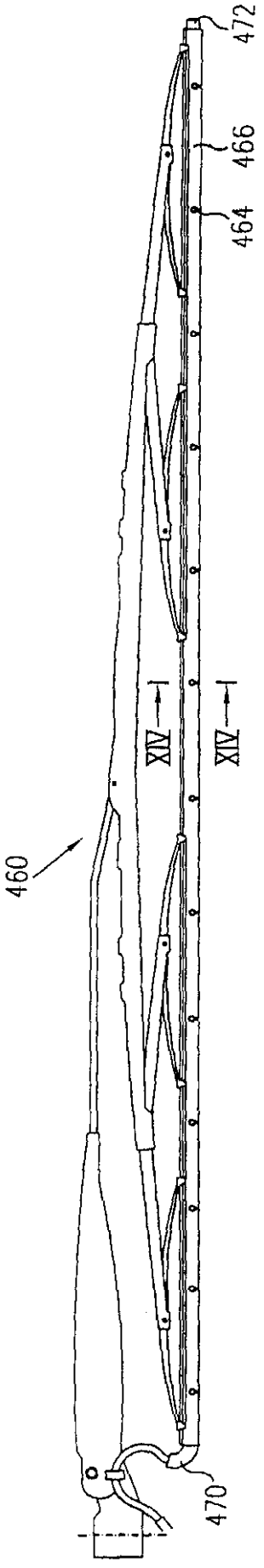

FIG. 14

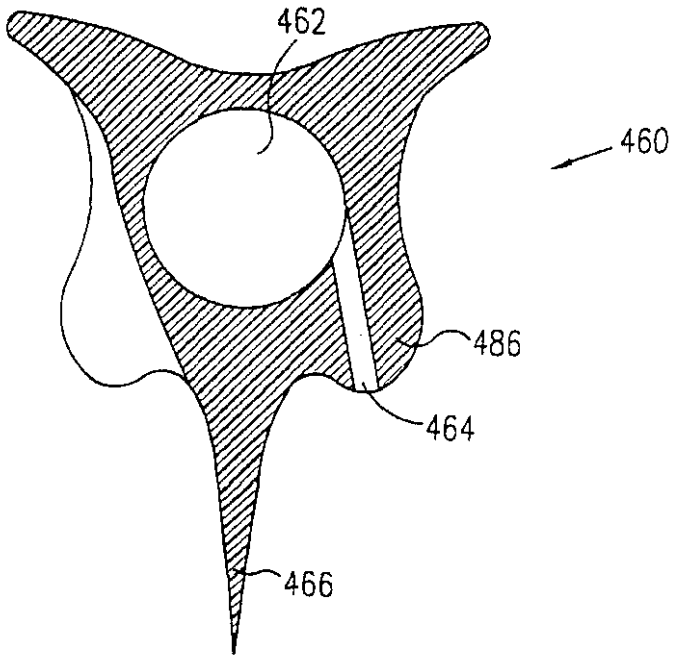

FIG. 15

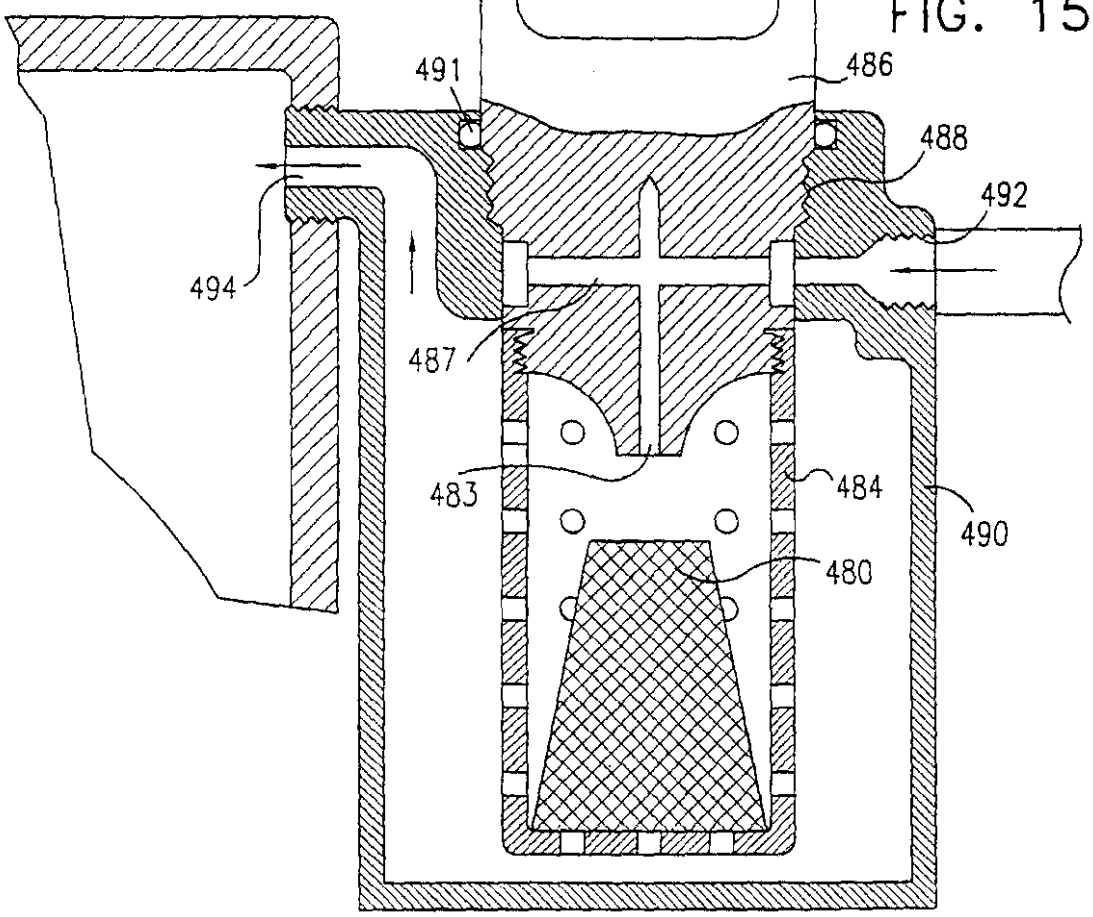
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FIG. 16

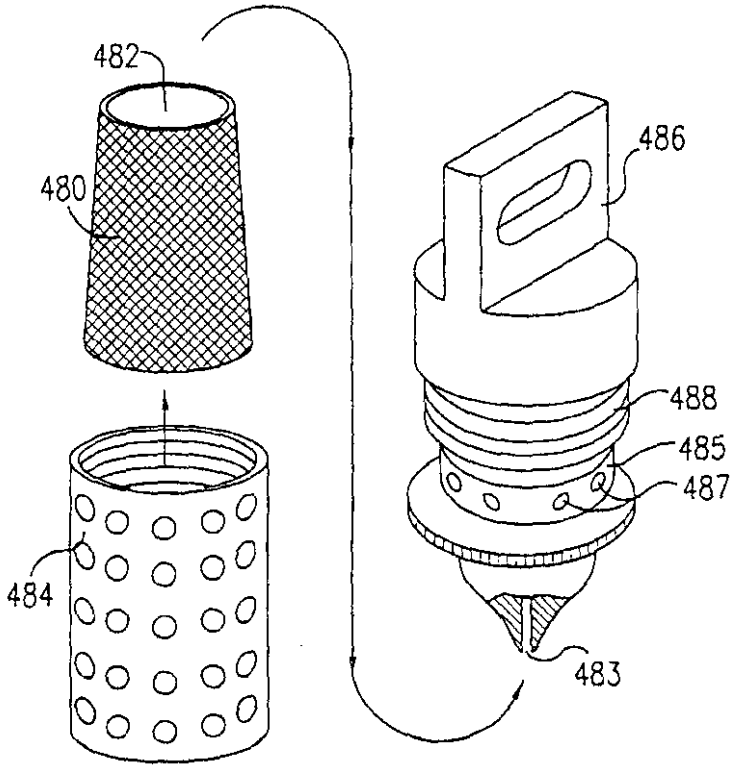
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FIG. 17

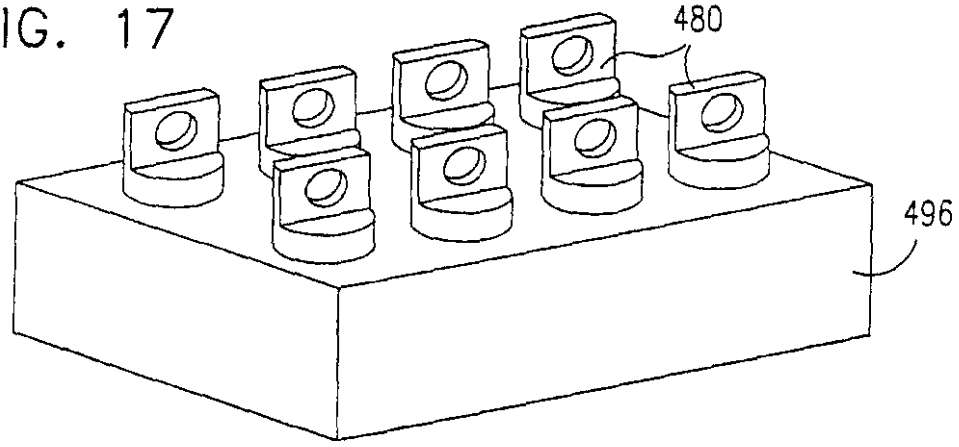
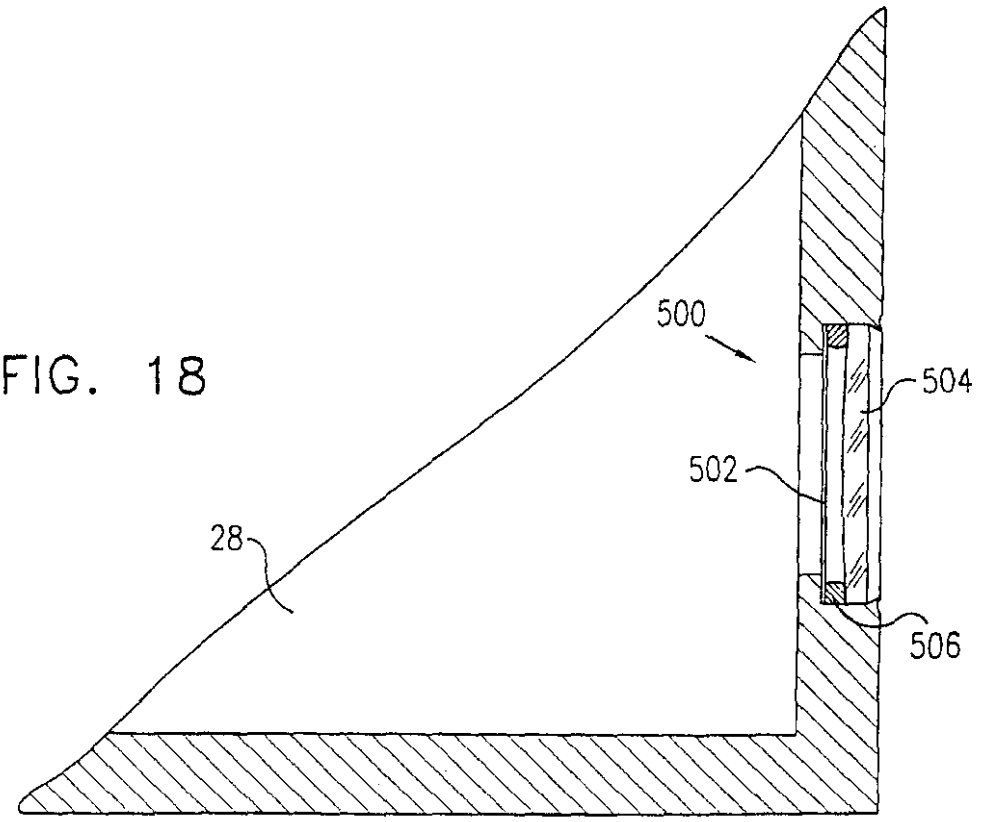
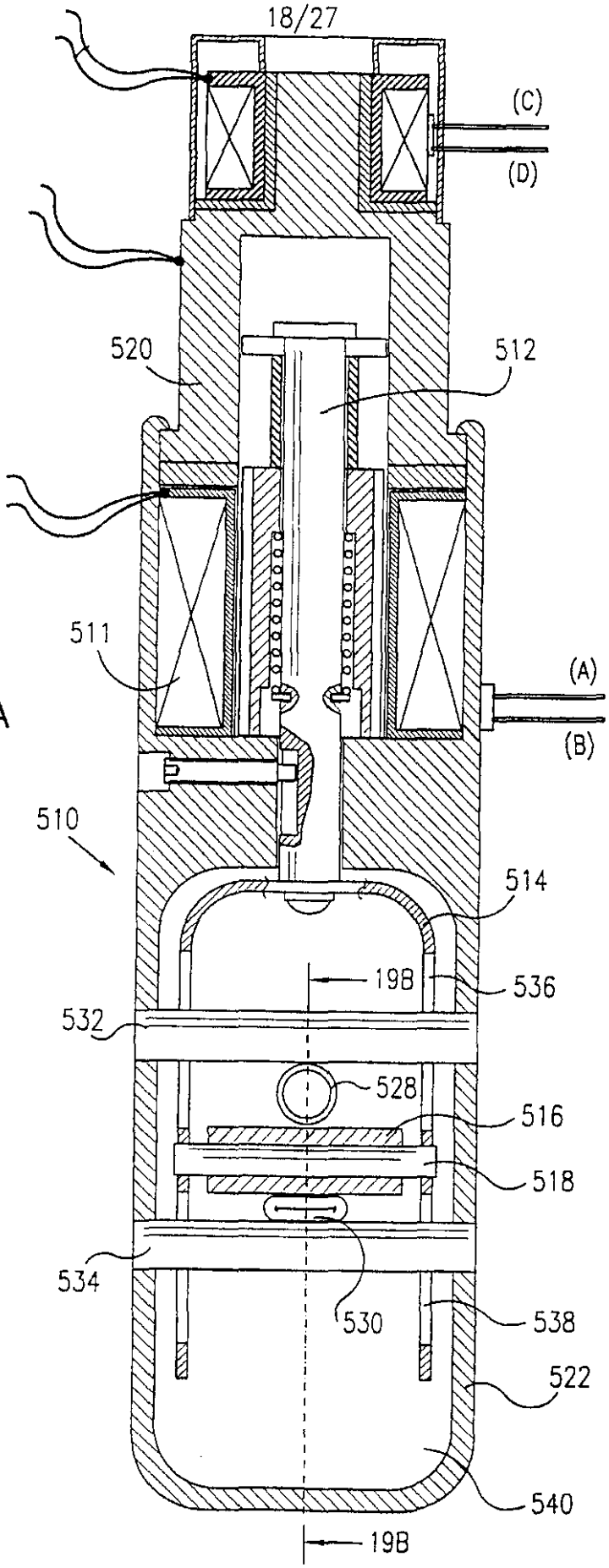


FIG. 18




(C)
(D)
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511
(A)
(B)
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19B
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534
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522
540
19B

FIG. 19A

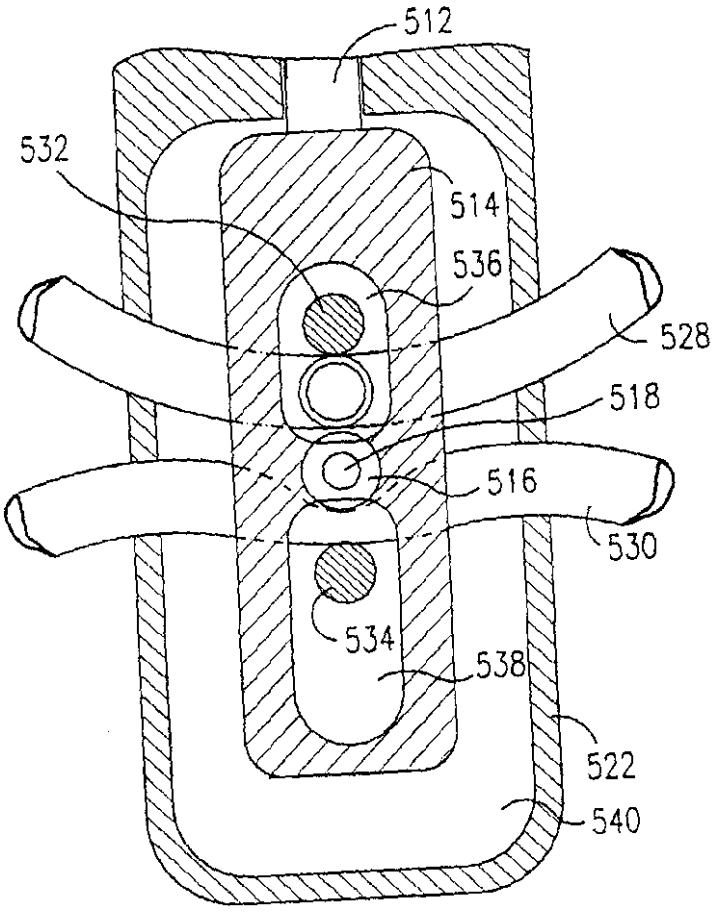
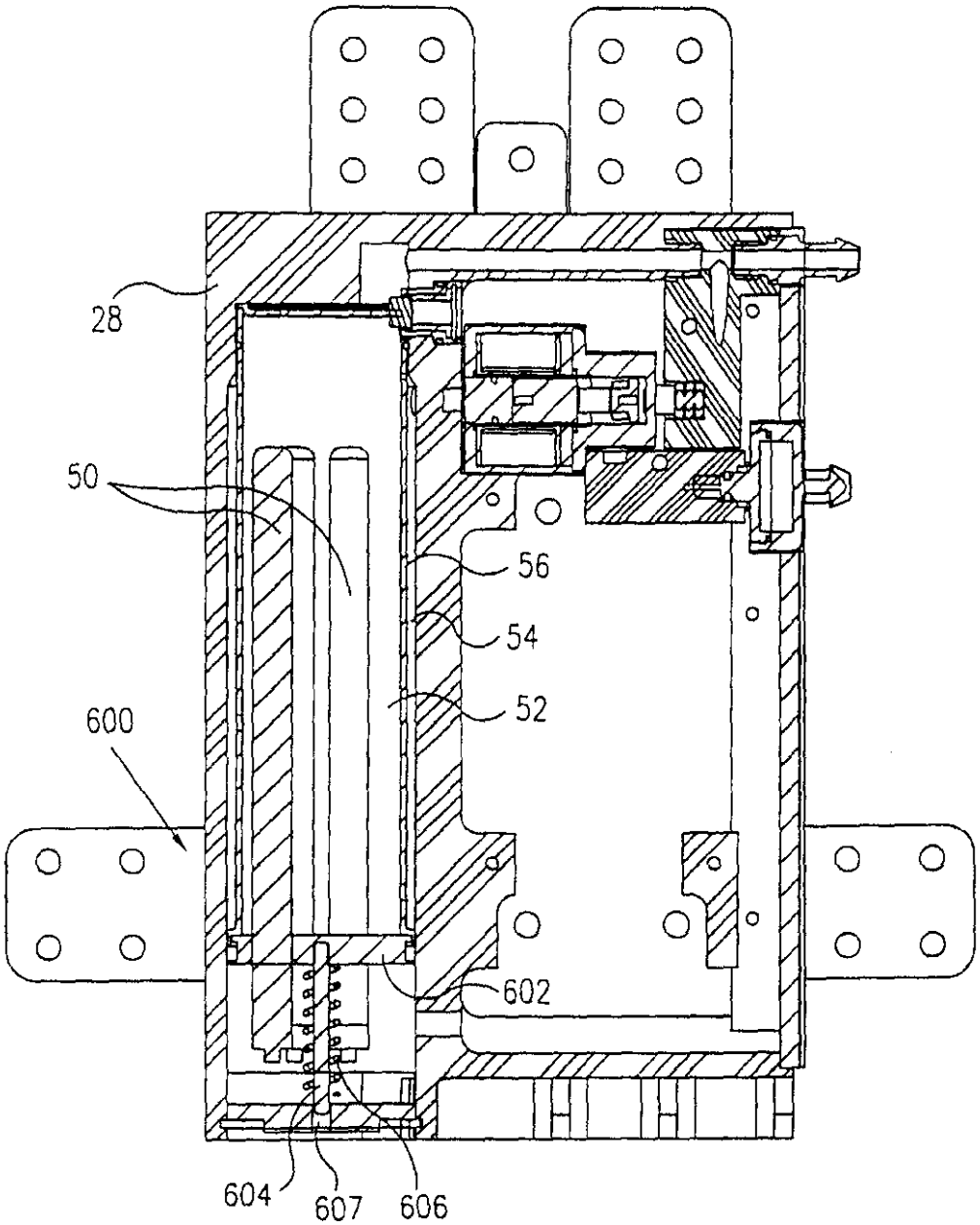


FIG. 19B

FIG. 20



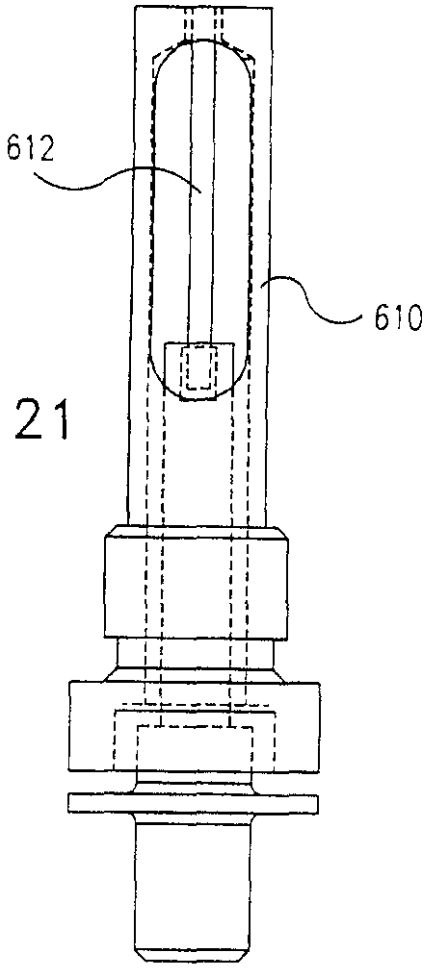


FIG. 21

FIG. 22

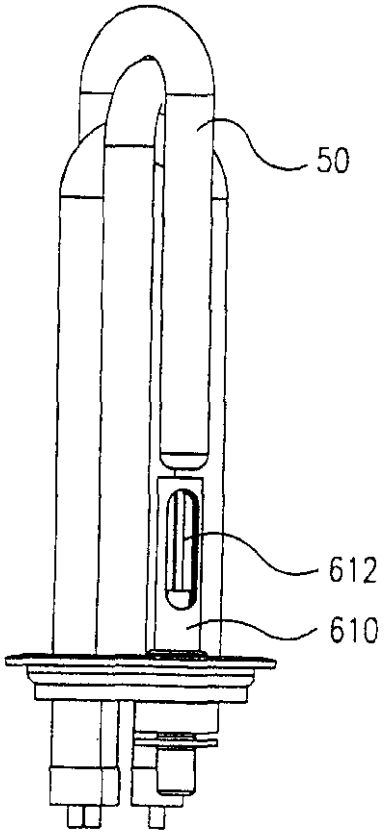


FIG. 23

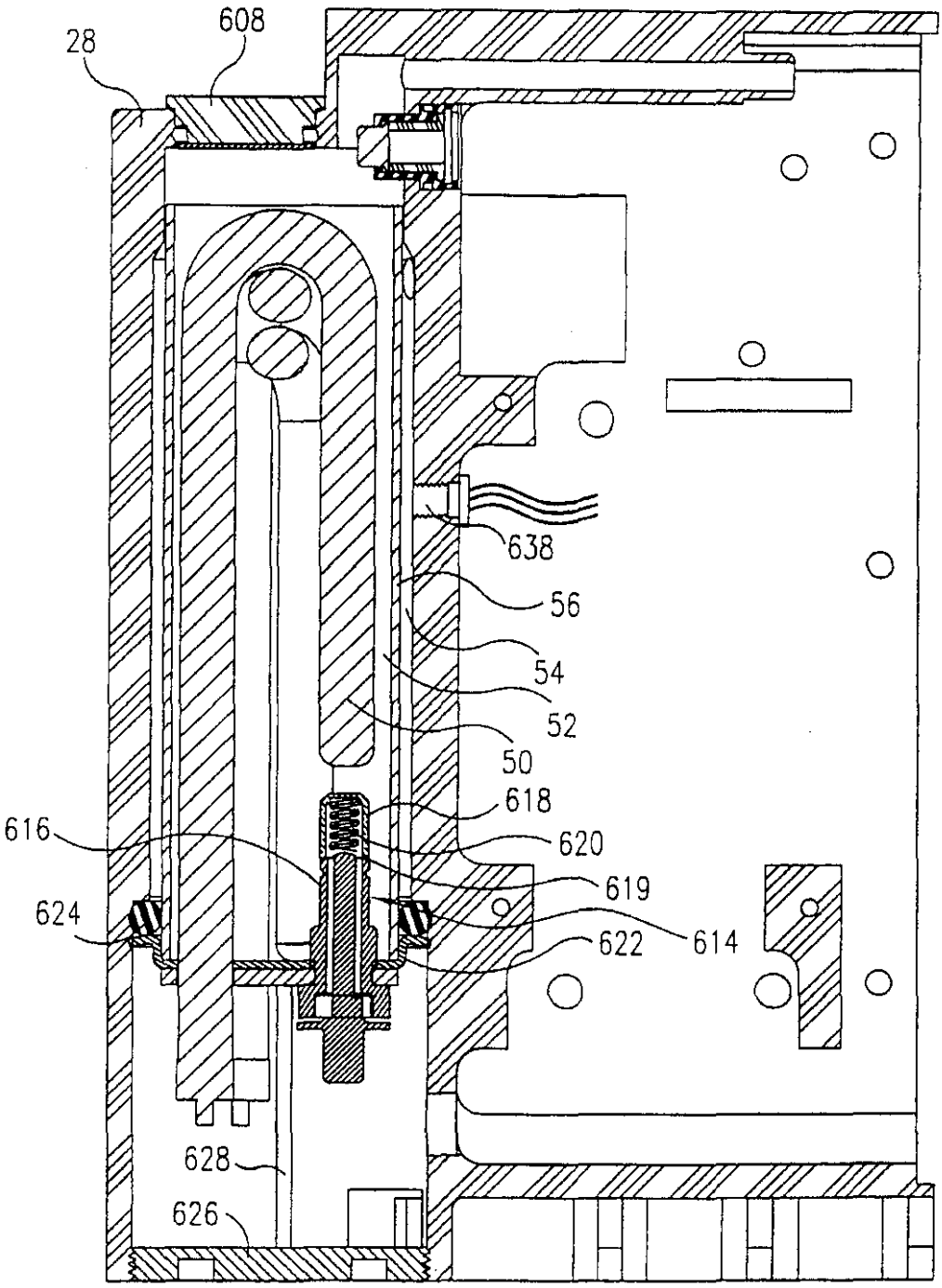


FIG. 24

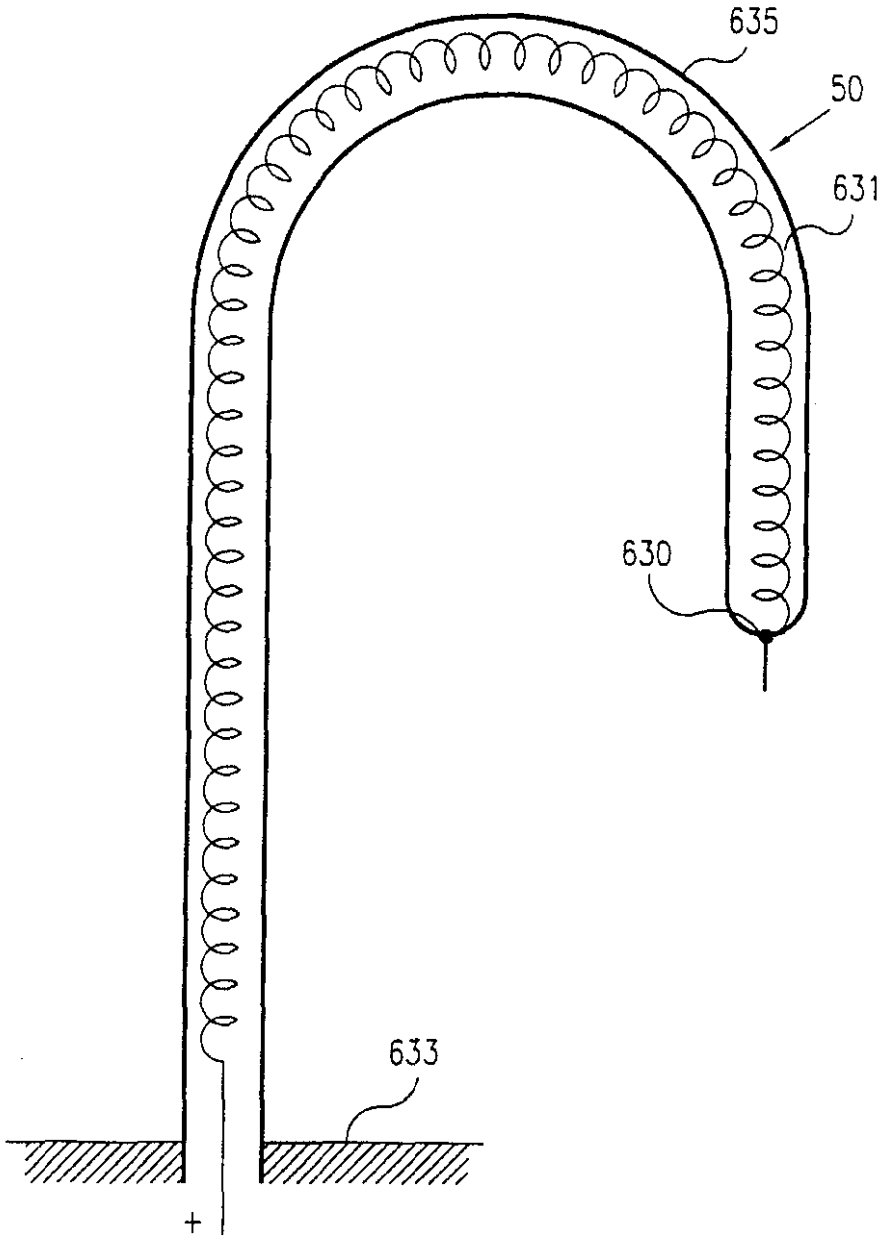


FIG. 25

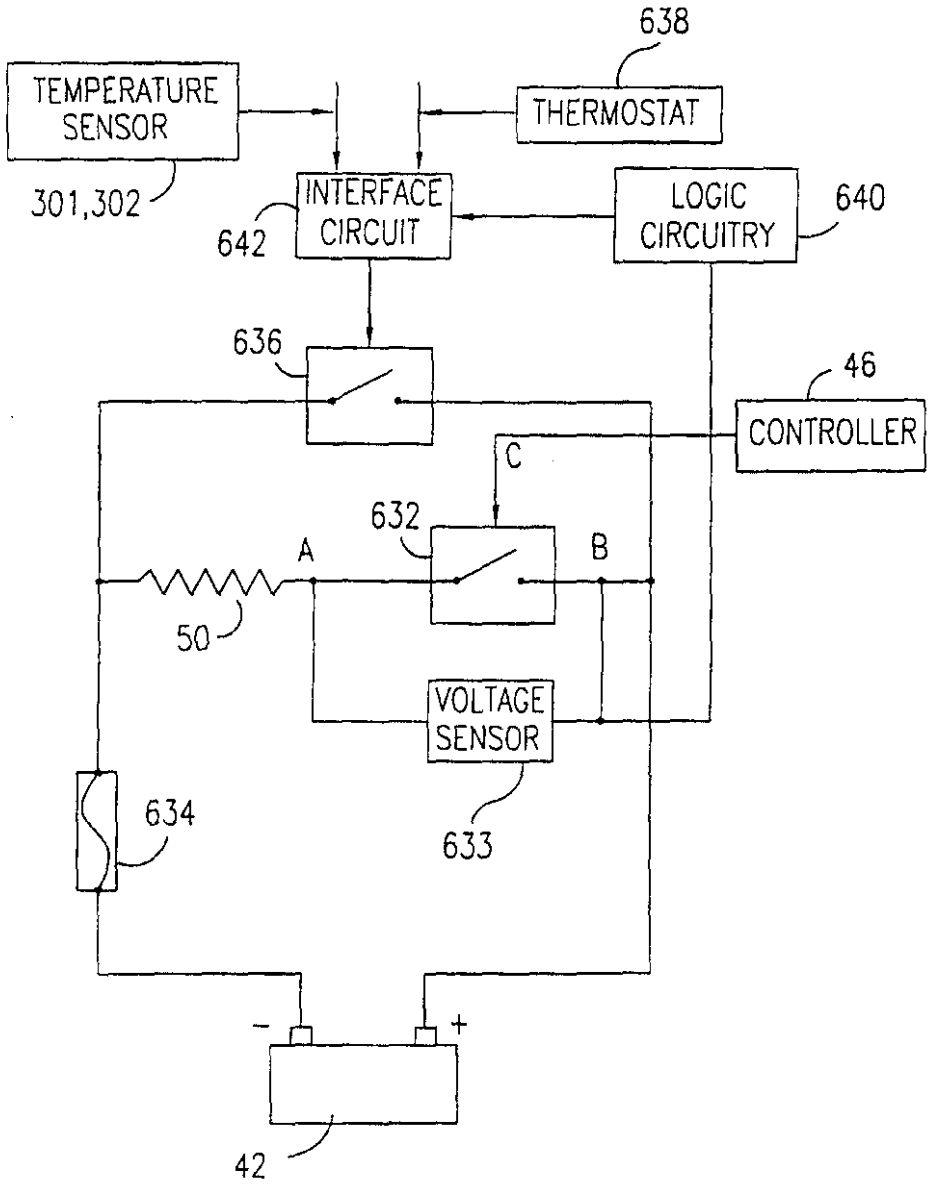

638
TEMPERATURE SENSOR
THERMOSTAT
301,302
642
INTERFACE CIRCUIT
LOGIC CIRCUITRY
640
636
46
CONTROLLER
C
632
A
B
50
VOLTAGE SENSOR
634
633
-
+
42

FIG. 27

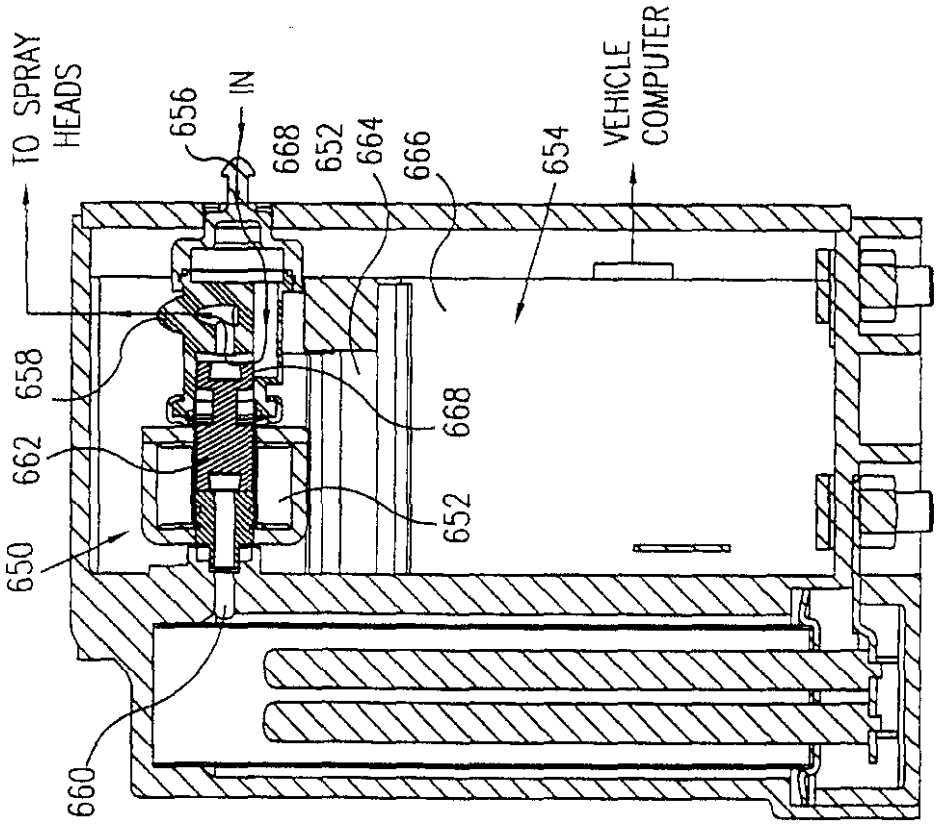

TO SPRAY HEADS
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FIG. 26

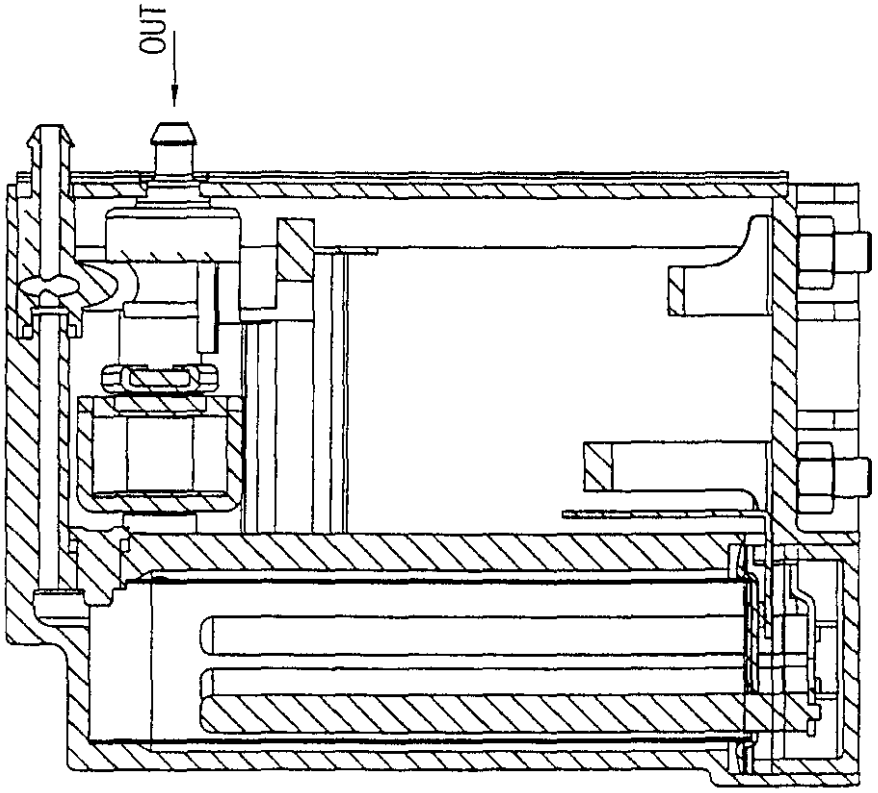

OUT

FIG. 28

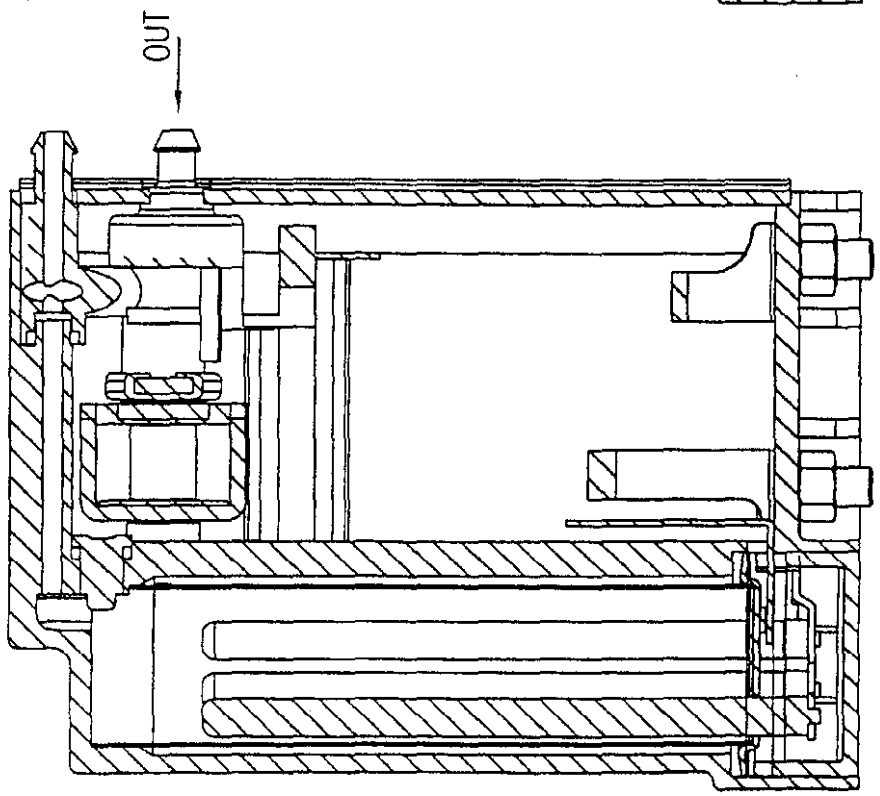
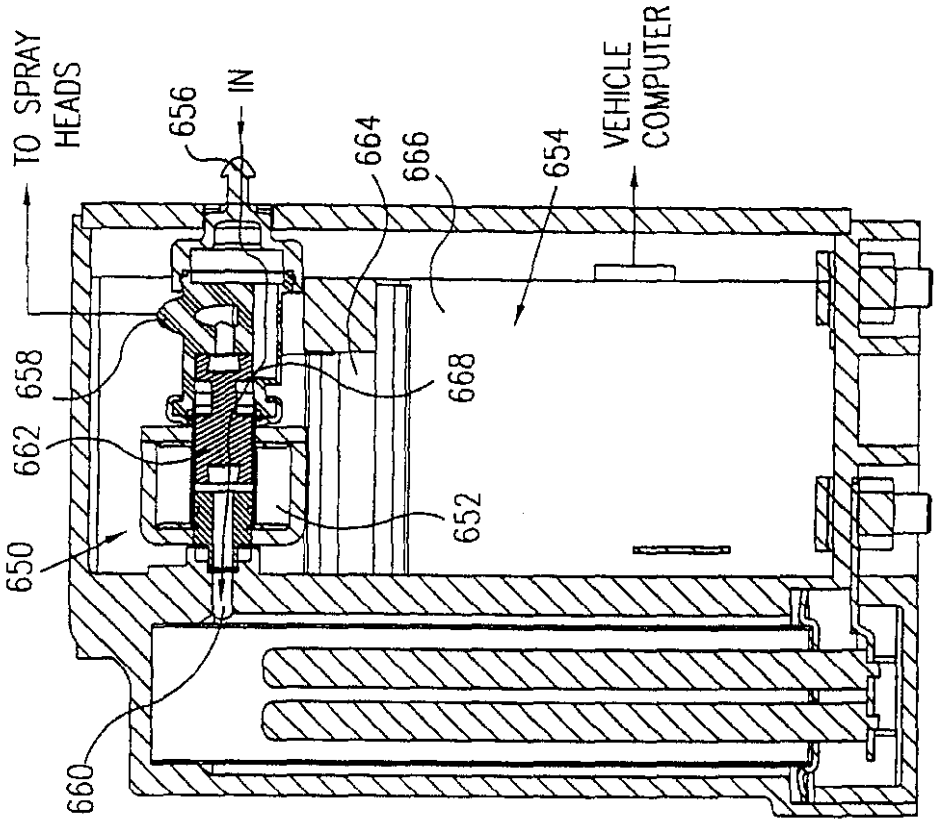

OUT

FIG. 29


TO SPRAY HEADS
656
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/25778

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B05B 1/10
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 239/284.1, 284.2, 130, 131, 135, 139; 251/6, 7; 392/479, 480, 481, 485, 488, 489, 491, 492, 478; 15/250.05

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PLUS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,354,965 A (LEE) 11 October 1994, col. 11, lines 39-53.	7, 22
Y, E	US 5,988,529 A (SUHRING) 23 November 1999, col. 4, lines 50-53.	11, 22
Y	US 3,979,068 A (APPLEBAUM) 07 September 1976, col. 2, line 8-18.	11, 22
X	US 5,383,247 A (NICKEL) 24 January 1995, col. 4, lines 26-29.	17, 18, 22
X, P	US 5,957,384 A (LANSINGER) 28 September 1999, col. 9, lines 29-42.	17, 18, 22
X, P	US 5,947,348 A (BRISKI) 07 September 1999, col. 3, lines 18-37.	25-32

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other *special reason (as specified)*	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 07 FEBRUARY 2000	Date of mailing of the international search report 11 APR 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Harold Joyce Diane Smith for Telephone No. (703) 308-0274

Form PCT/ISA/210 (second sheet)(July 1992)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/25778

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

239/284.1, 284.2, 130, 131, 135, 139; 251/6, 7; 392/479, 480, 481, 485, 488, 489, 491, 492, 478; 15/250.05

[19]中华人民共和国国家知识产权局

[51]Int. Cl[7]
B05B 1/10

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[21]申请号 99813991.2

[43]公开日 2002年1月2日

[11]公开号 CN 1329521A

[22]申请日 1999.11.2 [21]申请号 99813991.2
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[32]1998.11.6 [33]US [31]09/187,654
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[85]进入国家阶段日期 2001.6.1
[71]申请人 显微加热公司
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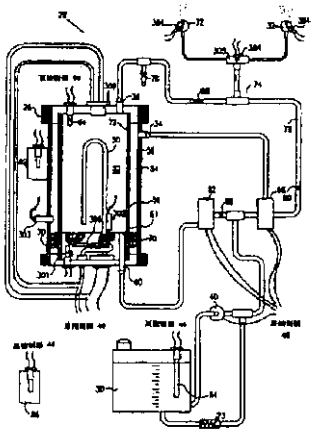
约瑟夫·罗格钦斯基
尤里·阿尔卡谢夫斯基
[74]专利代理机构 中国国际贸易促进委员会专利商标事务所
代理人 王彦斌

权利要求书8页 说明书29页 附图页数27页

[54]发明名称 机动车车窗的清洗或去冰装置

[57]摘要

机动车车窗(24)的清洗或去冰装置(20)包括:贮槽(30),它用于 在其中容纳清洗流体;容器,它具有入口,来自贮槽的清洗流体通过 入口而被接收,和出口,流体通过出口而排出,以便清洗机动车车窗; 以及第一加热元件(50),它设置在容器中,用于加热容器中的流体; 其特征在于辅助加热元件(306)设置在容器中用于加热容器中的流 体,其中辅助加热元件设置在容器的底部部分上,并进行运行以加热 一定量的流体,这个量的流体不需足以覆盖第一加热元件。



ISSN1008-4274

权　利　要　求　书

1. 一种机动车车窗的清洗或去冰装置，该装置包括：

贮槽，它用于在其中容纳清洗流体；

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，以便清洗机动车车窗；以及

第一加热元件，它设置在容器中，用以加热容器内的流体；

其特征在于，

辅助加热元件，它被设置在容器中，用以加热容器内的流体，其中，所述辅助加热元件被设置在容器的底部部分上，并进行运行以加热一定流体量，该流体量不需足以覆盖第一加热元件。

2. 根据权利要求 1 的装置，其特征在于，该装置还包括若干传感器，它们向控制器输送数据，数据至少涉及温度以及容器内流体的流体水平中的一个，所述控制器根据数据控制第一和辅助加热元件的激励。

3. 根据权利要求 1 的装置，其特征在于，该装置还包括安装在所述辅助加热元件中的温度传感器。

4. 一种机动车车窗的清洗或去冰装置，该装置包括：

贮槽，它用于在其中容纳清洗流体；

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出；

喷雾头，它与出口进行流体联通，流体通过它喷在机动车车窗上；以及

加热元件，它设置在容器中，用于加热在所述容器中的流体；

其特征在于，

一个温度传感器，它安装在所述喷雾头的邻近，所述温度传感器与控制器进行通讯联络，该控制器根据所述温度传感器检测到的温度，控制所述加热元件的加热。

5. 一种机动车车窗的清洗或去冰装置，该装置包括：

贮槽，它用于在其中容纳清洗流体；

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出；

喷雾头，它与出口进行流体联通，流体通过它喷在机动车车窗上；以及

加热元件，它设置在容器中，用于加热在所述容器中的流体；

其特征在于，

一个风速传感器，它与控制器进行通讯联络，其中，所述控制器将由所述风速传感器检测到的风速与从喷雾头喷出的流体温度相关联，并根据由所述风速传感器检测到的风速控制所述加热元件的加热。

6. 根据权利要求 5 的装置，其特征在于，该装置还包括机动车速度传感器，其中，所述控制器也将由所述机动车速度传感器检测到的机动车速度与从喷雾头喷出的流体温度相关联，并根据由所述机动车速度传感器检测到的机动车速度控制所述加热元件的加热。

7. 一种机动车车窗的清洗或去冰装置，该装置包括：

贮槽，它用于在其中容纳清洗流体；

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，以便清洗机动车车窗；以及

第一加热元件，它设置在容器中，用以加热容器内的流体；

其特征在于，

泵送系统，该泵送系统与所述贮槽和所述容器进行流体联通，并有选择地将流体从所述贮槽泵送至所述容器中，以及将所述流体从所述容器泄出返回至所述贮槽。

8. 根据权利要求 7 的装置，其特征在于，所述泵送系统至少包括一个螺线管，该螺线管与所述贮槽及所述容器进行流体联通，并可从第一位置切换至第二位置，其特征在于，在所述第一位置时，所述至少一个螺线管允许进行从所述贮槽至所述容器的流动，并基本阻止将所述流体从所述容器泄水排回至所述贮槽，其特征还在于，在所述第

二位置时，所述至少一个螺线管允许将所述流体从所述容器泄出排回至所述贮槽，并基本阻止进行从所述贮槽至所述容器的流动。

9. 根据权利要求 7 的装置，其特征在于，所述泵送系统包括可逆泵，它在第一操作定向时，将所述流体从所述贮槽泵送至所述容器，而在第二操作定向时，将所述流体从所述容器泵回所述贮槽。

10. 根据权利要求 9 的装置，其特征在于，所述可逆泵包括齿轮泵。

11. 一种机动车车窗的清洗和去冰装置，该装置包括：

贮槽，它用于在其中容纳清洗流体；

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出；

喷雾头，它与出口进行流体联通，流体通过它喷在机动车车窗上；以及

挡风玻璃雨刷，它用于擦净所述车窗；

其特征在于，

所述喷雾头包括多出口喷雾头，它包括若干喷雾出口。

12. 根据权利要求 11 的装置，其特征在于，该装置还包括控制器，它控制所述若干出口的喷雾形式。

13. 根据权利要求 12 的装置，其特征在于，该装置还包括传感器，用于检测所述挡风玻璃雨刷的角向位置，其特征在于，所述控制器根据所述挡风玻璃雨刷的角向位置控制所述若干出口的喷雾形式。

14. 根据权利要求 11 的装置，其特征在于，该装置还包括安装在挡风玻璃雨刷上的凸轮，所述凸轮有选择地打开出口，使所述流体得以由此流动通过。

15. 根据权利要求 12 的装置，其特征在于，该装置还包括驱动挡风玻璃雨刷的马达以及用以检测所述马达的扭矩的传感器，其特征在于，所述控制器根据所述马达的扭矩控制所述若干出口的喷雾形式。

16. 根据权利要求 11 的装置，其特征在于，所述挡风玻璃雨刷在两个行程的极限之间擦拭所述车窗，且所述挡风玻璃雨刷能放置在夏

季停车模式和冬季停车模式，并且，在所述夏季停车模式时，所述雨刷一般静止于行程极限之一上，而且，在所述冬季停车模式时，所述雨刷位于所述行程极限之间。

17. 一种机动车车窗的清洗和去冰装置，该装置包括:

贮槽，它用于在其中容纳清洗流体;

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出;

喷雾头，它与出口进行流体联通，流体通过它喷在机动车车窗上;以及

挡风玻璃雨刷，它用于擦净所述车窗;

其特征在于，

所述挡风玻璃雨刷具有通过其中而形成的纵向中心孔，用于流体由此流动通过，其中，所述中心孔与成形于所述雨刷中的若干出口孔进行流体联通，用于将流体喷在所述车窗上。

18. 根据权利要求 17 的装置，其特征在于，流体在所述雨刷的一端进入所述中心孔，而所述雨刷的相对端是基本密封的。

19. 一种机动车车窗的清洗和去冰装置，该装置包括:

贮槽，它用于在其中容纳清洗流体;

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，用于清洗机动车车窗;以及

其特征在于，

还包括药夹，该药夹在流体排出之前向流体分送添加剂。

20. 根据权利要求 19 的装置，其特征在于，所述药夹包括所述添加剂的固体块。

21. 根据权利要求 19 的装置，其特征在于，所述药夹装配在穿孔的容器中，该穿孔容器被塞子所封口，所述塞子包括螺纹颈以及成形有若干穿孔的颈部分，所述孔与中心孔进行流体联通，而中心孔转而又与所述穿孔容器进行流体联通，其特征在于，所述螺纹颈能拧入至一个储器中，流体能通过该储器流入容器内，其特征在于，当流体流

动通过所述储器时，添加剂与流体混合。

22. 机动车车窗的清洗或去冰装置，该装置包括:

贮槽，它用于在其中容纳清洗流体;

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，用于清洗机动车车窗；以及

其特征在于，

还包括一种流体核定系统，用于检查被核定流体的使用。

23. 根据权利要求 22 的装置，其特征在于，所述流体核定系统包括薄膜，该薄膜由这样的材料制成，如果它不是存在于核定使用的流体中时，它就会分解。

24. 一种机动车车窗的清洗或去冰装置，该装置包括:

贮槽，它用于在其中容纳清洗流体;

容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，用于清洗机动车车窗；以及

其特征在于，

还至少包括一根与流体进行流体联通的管子以及螺线管，该螺线管有选择地挤压和密封所述至少一根管子，用以阻止流体由此流动通过，和有选择地使流体得以由此流动通过。

25. 一种螺线管，该螺线管包括:

管状接受构件;

至少一根管子，它通过所述管状接受构件;

一根轴，它布置成能相对所述管状接受构件进行大体为线性的运动，所述轴有选择地倚靠所述管状接受构件挤压和密封所述至少一根管子，用以阻止流体由此流动通过，以及有选择地从所述至少一根管子移开，使流体得以由此流过；以及

电磁装置，它大致线性地移动所述轴。

26. 根据权利要求 25 的螺线管，其特征在于，所述至少一根管子具有圆形横截面。

27. 根据权利要求 25 的螺线管，其特征在于，所述至少一根管子

具有非圆形横截面。

28. 根据权利要求 25 的螺线管，其特征在于，该螺线管包括两根所述管子，其中，所述电磁装置将所述轴移动至一个位置，从而流体能从两根所述管子中都通过。

29. 根据权利要求 25 的螺线管，其特征在于，所述至少一根管子具有弹性，以致当所述至少一根管子从受压状态回复至非受压状态时，所述至少一根管子在所述轴上作用一个力，以帮助所述轴的大致为线性的运动。

30. 根据权利要求 4 的装置，其特征在于，该装置还包括用以防止由于流体冻结引起损坏的装置。

31. 根据权利要求 30 的装置，其特征在于，用以防止损坏的所述装置包括一个配置成在所述容器内滑移的平台，所述平台可由于在所述流体冻结期间，所述流体压靠于其上的力而实施滑移。

32. 根据权利要求 30 的装置，其特征在于，用以防止损坏的所述装置包括一个装备在所述容器上的盖，该盖可由于在所述流体冻结期间，所述流体压靠于其上的力而实施从所述容器移开。

33. 根据权利要求 4 的装置，其特征在于，该装置还包括所述加热元件的电源切断装置。

34. 根据权利要求 33 的装置，其特征在于，所述电源切断装置包括熔丝，它电连接至所述加热元件。

35. 根据权利要求 34 的装置，其特征在于，所述熔丝位于所述容器之内，并与所述容器中的所述清洗流体相接触。

36. 根据权利要求 34 的装置，其特征在于，所述熔丝包括一个主体，盖部分在焊接连接处被焊接至主体上，所述盖部分受偏压装置的偏压，所述熔丝通过所述焊接连接电连接至所述加热元件，当达到预定温度时，所述焊接连接由于至少其部分熔化而变弱，偏压装置将所述盖部分推出所述主体，从而引起所述加热元件电源的切断。

37. 根据权利要求 34 的装置，其特征在于，所述熔丝安装在底座上，底座相对所述容器借助底盖而密封，因底盖将所述底座压靠在安

装于所述容器中的 O 形圈上。

38. 根据权利要求 33 的装置，其特征在于，所述电源切断装置包括熔丝，它实际上位于所述加热元件之内，并电连接至所述加热元件。

39. 根据权利要求 33 的装置，其特征在于，所述电源切断装置包括第一 FET，它与所述控制器进行电通信联络，熔丝位于所述容器之外，并在运行中与所述第一 FET 相连接，第二 FET 在运行中与所述熔丝相连接，所述第二 FET 至少与所述温度传感器中的一个温度传感器进行通信联络，定温器安装在所述容器中，而逻辑线路与所述第二 FET 位于电通信联络之中。

40. 根据权利要求 39 的装置，其特征在于，如果没有命令信号从所述控制器输送给所述第一 FET，所述第一 FET 开路，而所述加热元件未被激励。

41. 根据权利要求 39 的装置，其特征在于，如果命令信号从所述控制器输送给所述第一 FET，所述第一 FET 闭合，所述加热元件被激励。

42. 根据权利要求 39 的装置，其特征在于，如果没有命令信号从所述控制器输送给所述第一 FET，但跨越所述第一 FET 存在一个近乎零的电压降，于是所述第二 FET 被命令闭合，从而通过所述熔丝输送电流，它断开所述熔丝，并切断所述加热元件的电源。

43. 根据权利要求 39 的装置，其特征在于，如果命令信号从所述控制器输送给所述第一 FET，但跨越所述第一 FET 存在一个一般大于零的电压降，于是所述机动车车窗的清洗或去冰装置被命令停止运行。

44. 根据权利要求 4 的装置，其特征在于，该装置还包括一个螺线管，它与安装在所述容器内的控制线路印刷电路板(PCB)进行直接电通信联络，所述螺线管确定，所述流体是直接流至所述喷雾头，或通过所述容器流至所述喷雾头。

45. 根据权利要求 44 的装置，其特征在于，所述螺线管装备至所述 PCB 上。

46. 根据权利要求 44 的装置，其特征在于，所述 PCB 可有选择地

连接至机动车计算机，其中，所述螺线管和所述机动车车窗清洗或去冰装置的运行可至少由所述 PCB 与所述机动车计算机中之一加以控制。

47. 根据权利要求 7 的装置，其特征在于，所述泵送系统包括第三运行定向，其中所述泵送系统停止，而流体仍流向所述容器，并只在一个延迟之后，流体从向着所述容器的方向改线至离开所述容器的方向。

说　　明　　书

机动车车窗的清洗或去冰装置

本发明总体上涉及机动车车窗的清洗或去冰装置。

在本领域中已知有各种将热水或其它清洗流体喷雾在机动车车窗上的方法和装置。热水对在寒冷气候时去除机动车挡风玻璃上的冰特别有效。此去除冰的功能要求驾车人在机动车挡风玻璃能去冰之前、流体被加热时进行等待。然而，本领域中已知的方法和装置是不实用的，因为它们通常应用机动车发动机本身发出的热或电以加热流体，这要求驾车人等待一个长得令人不能接受的时间，以便流体达到适当的温度。

应用与机动车发动机无关的机动车电池加热流体也是有问题的，因为，加热足够量的流体以便有效地对挡风玻璃去冰要求引出大的电流。电池通常不能提供足够的电流用以在合理的时间总量后加热机动车的清洗流体的整个贮槽。虽然已提在流体即将被喷雾在挡风玻璃上时，在线加热流体的方法和装置，电池也不能提供足够的电流，以便将足够体积的雾柱加热至足够高的温度，以获得有效的去冰。

美国专利 5509606 描述了一种汽车挡风玻璃的热洗装置，它包括一个容器，清洗流体从贮槽泵送至容器中，流体在它被喷雾在挡风玻璃上之前于容器中由电加热元件加热。容器是绝缘的，并包括一个定温器，用以确保流体的温度不超过预定的最高值。容器保持充满，在需要时对其加热，以便使泵入容器中的冷流体达到要求的温度。

美国专利 5118040 描述了一种清洗机动车车窗玻璃用的电装置。绝缘容器置于冷清洗流体的贮槽与至汽车车窗的雾柱出口之间，其位置低于贮槽，从而保持流体被充满。当机动车点着火时，电加热器加热容器中的流体，并在机动车使用时，保持运行。但是，没有快速启动并加热以便对机动车车窗去冰的装置。

美国专利 4090668 描述了一种挡风玻璃的清洗和去冰系统，它包

括一个贮槽，贮槽中有一个密封的容器。泵将清洗流体从贮槽转送至容器，然而从容器转送至若干喷嘴。加热的发动机冷却剂通过贮槽中的管道。电阻线加热贮槽中的流体，只要温度降低至一定的最低值以下。电磁阀将喷雾从槽中引至机动车的前或后车窗，但是没有建议应用阀对流体进行任何其它目的的控制。

美国专利 5012977 描述了一种机动车车窗清洗机，其中，清洗机的流体在贮槽中加热，而用于将流体喷雾在机动车车窗上的泵具有可变的出口压力。流体在贮槽内的温度受到检测，而泵的出口压力与清洗机流体的温度成反比地加以变化，以保持流体更稳定地沉积在车窗上，因为流体的粘性随温度而改变。

美国专利 5354965 描述了一种对摩托车中一个容积的挡风玻璃清洗流体进行电加热的系统。一个容器内充装着该容积的欲加热的流体，应用 PTC 热敏电阻或其它电加热元件。在流体喷雾至挡风玻璃上之前，控制线路根据周围的主要温度调节流体加热的时间长度。当摩托车马达不运行时，线路还阻止流体加热的操作。

转让给本受让人的 PCT 申请 PCT/US98/13023 描述了去冰装置，其中设置了一个容器，用于在流体喷射至机动车车窗之前，加热清洗流体。在流体输入容器之前，最好借助使电流流过容器中的加热元件约一分钟或更少，使容器进行预热。当预热完成，允许流体进入容器，并通过与其接触而快速加热，由于部分流体的蒸发，导至容器中压力的增加。然后在要求的温度和压力下将流体射出，从而对车窗进行清洗和/或去冰。

虽然容器的预热只从机动车电池中引出适度的电输入，但它能产生足够量的热流体，在机动车发动前，比本领域中任何已知的实际车窗清洗系统更快地对车窗进行去冰。此外，由于流体蒸发产生的压力有助于去冰或清除流体喷雾在车窗上时通过的管道或喷嘴中的其它阻塞。还应指出的是，将加热流体喷雾在车窗的外表面还能有效地对其内表面进行扫雾。

本发明的一个目的就是对 PCT 申请 PCT/US98/13023 中叙述的机

动车车窗的清洗或去冰装置和方法加以改进。

在本发明的较优实施例中，设置了一台容器，用于在将流体喷向机动车车窗之前加热清洗流体。在流体被输入容器之前，容器最好借助使电流通过容器中的加热元件例如约一分钟加以预热。当预热完成时，允许流体进入容器，流体通过与此处接触而快速加热，由于部分流体汽化导至容器中的压力增加。于是，流体在要求温度和压力下被排出，从而对车窗进行清洗和/或去冰。

虽然容器的预热只从机动车电池中引出适度的电输入，但它能产生足够量的热流体，在机动车发动前，比本领域中任何已知的实际车窗清洗系统更快地对车窗进行去冰。

在本发明的某些较优实施例中，在初始流体量已被加热，并从容器排出后，另一个量被输入容器，并被立即加热。一旦另一个量已达到要求的温度，它也被排出，且最好在几秒钟的延迟之后。此过程按重复加热/排放循环持续至车窗已被完全洗净和去净冰。加热/排放循环最好按系列加以定时，它们的参数，诸如排放持续时间以及排放之间的间隔，随机动车的周围温度和未加热流体加以改变。

应明白的是，在本专利申请文本及在权利要求中应用的名词“机动车”可指具有车窗的任何类型的带轮机动车，诸如汽车或卡车，也可指船只或飞机。此外，名词“车窗”虽然通常指机动车的挡风玻璃，也能指任何透明表面，包括侧窗或后窗以及外部反光镜，还有前灯的罩等。此外，每当在本申请及权利要求中应用名词“清洗”以涉及有关将热流体喷雾在车窗上的操作时，此名词应理解为也包括去冰。本领域的技术人员将看到，本发明的原理可用于对其它表面进行清洗和去冰，包括例如内窗户和反光镜，也可输送其它目的用的流体。例如，本发明的系统提供一条旁通路线，用于使清洗流体能直接喷在挡风玻璃上，以便对其进行日常清洗。

从而根据本发明的较优实施例提出一种机动车车窗的清洗或去冰装置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过

出口而排出，以便清洗机动车车窗；以及第一加热元件，它设置在容器中，用以加热容器内的流体；其特征在于辅助加热元件，它被设置在容器中，用以加热容器内的流体，其中，辅助加热元件被设置在容器的底部部分上，并进行运行以加热一定流体量，该流体量不一定足以覆盖第一加热元件。

根据本发明的较优实施例还设置了若干传感器，它们向控制器输送数据，数据至少涉及温度以及容器内流体的流体水平中的一个，控制器根据数据控制第一和辅助加热元件的激励。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出；喷雾头，它与出口进行流体联通，流体通过它喷在机动车车窗上；以及加热元件，它设置在容器中，用于加热在容器中的流体；其特征在于，一个温度传感器，它安装在喷雾头的邻近，温度传感器与控制器进行通讯联络，该控制器根据温度传感器检测到的温度，控制加热元件的加热。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出；喷雾头，它与出口进行流体联通，流体通过它喷在机动车车窗上；以及加热元件，它设置在容器中，用于加热在容器中的流体；其特征在于，一个风速传感器，它与控制器进行通讯联络，其中，控制器将由风速传感器检测到的风速与从喷雾头喷出的流体温度相关联，并根据由风速传感器检测到的风速控制加热元件的加热。

根据本发明的较优实施例还提出一种机动车速度传感器，其特征在于，控制器也将由机动车速度传感器检测到的机动车速度与从喷雾头喷出的流体温度相关联，并根据由机动车速度传感器检测到的机动车速度控制加热元件的加热。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装

置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，以便清洗机动车车窗；以及第一加热元件，它设置在容器中，用以加热容器内的流体；其特征在于泵送系统，该泵送系统与贮槽和容器进行流体联通，并有选择地将流体从贮槽泵送至容器中，以及将流体从容器泄出返回至贮槽。

根据本发明的较优实施例，泵送系统至少包括一个螺线管，该螺线管与贮槽及容器进行流体联通，并可从第一位置切换至第二位置，其特征在于，在第一位置时，该至少一个螺线管允许进行从贮槽至容器的流动，并基本阻止将流体从容器泄出排回至贮槽，其特征还在于，在第二位置时，该至少一个螺线管允许将流体从容器泄出排回至贮槽，并基本阻止进行从贮槽至容器的流动。

根据本发明的较优实施例，泵送系统包括可逆泵，它在第一操作定向时，将流体从贮槽泵送至容器，而在第二操作定向时，将流体从容器泵回至贮槽。可逆泵最好包含齿轮泵。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出；喷雾头，它与出口进行流体联通，注体通过它喷在机动车车窗上；以及挡风玻璃雨刷，它用于擦净车窗；其特征在于，喷雾头包括多出口喷雾头，它包括若干喷雾出口。

根据本发明的较优实施例，设置了控制器，它控制若干出口的喷雾形式。

根据本发明的较优实施例，设置了传感器，用于检测挡风玻璃雨刷的角向位置，其特征在于，控制器根据挡风玻璃雨刷的角向位置，控制若干出口的喷雾形式。最好设置马达，该马达驱动挡风玻璃雨刷。

根据本发明的较优实施例，凸轮安装在挡风玻璃雨刷上，该凸轮有选择地打开出口，使流体得以由此流动通过。

根据本发明的较优实施例，设置了驱动挡风玻璃雨刷的马达以及

检测马达扭矩的传感器，其特征在于，控制器根据马达的扭矩控制若干出口的喷雾形式。

根据本发明的较优实施例，挡风玻璃雨刷在两个行程的极限之间擦拭车窗，且挡风玻璃雨刷能放置在夏季停车模式和冬季停车模式，其特征在于，在夏季停车模式时，雨刷一般静止于行程极限之一上，且特征还在于，在冬季停车模式时，雨刷位于行程极限之间。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装置，该装置包括贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出；喷雾头，它与出口进行流体联通，流体通过它喷在机动车车窗上；以及挡风玻璃雨刷，它用于擦净车窗；其特征在于，挡风玻璃雨刷具有通过其中而形成的纵向中心孔，用于流体由此流动通过，其特征在于，中心孔与成形于雨刷中的若干出口孔进行流体联通，用于将流体喷在车窗上。

根据本发明的较优实施例，流体在雨刷的一端进入中心孔，而雨刷的相对端则是基本密封的。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，用于清洗机动车车窗；以及其特征在于，还包括药夹，该药夹在流体排出之前向流体分送添加剂。

根据本发明的较优实施例，药夹包括添加剂的固体块。

此外，根据本发明的较优实施例，药夹装配在穿孔的容器中，该穿孔容器被塞子所封口，塞子包括螺纹颈以及成形有若干穿孔的颈部分，孔与中心孔进行流体联通，而中心孔转而又与穿孔容器进行流体联通，其特征在于，螺纹颈能拧入至一个储器中，流体能通过该储器流入容器内，其特征在于，当流体流动通过储器时，添加剂与流体混合。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装

置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，用于清洗机动车车窗；以及其特征在于，还包括一种流体核定系统，用于检查被核定流体的使用。

根据本发明的较优实施例，流体核定系统包括薄膜，薄膜由这样的材料制成，如果它不是存在于核定使用的流体中时，它就会分解。

根据本发明的较优实施例还提出一种机动车车窗的清洗或去冰装置，该装置包括：贮槽，它用于在其中容纳清洗流体；容器，它具有入口，来自贮槽的清洗流体通过入口而被接收，和出口，流体通过出口而排出，用于清洗机动车车窗；以及其特征在于，还至少包括一根与流体进行流体联通的管子以及螺线管，该螺线管有选择地挤压和密封该至少一根管子，用以阻止流体由此流动通过，和有选择地使流体得以由此流动通过。

根据本发明的较优实施例，还提出了用以防止由于流体冻结引起损坏的装置。

此外，根据本发明的较优实施例，用以防止损坏的装置包括一个配置成在容器内滑移的平台，该平台可由于在流体冻结期间，流体压靠于其上的力而实施滑移。

再此外，根据本发明的较优实施例，用以防止损坏的装置包括一个装备在容器上的盖，该盖可由于在流体冻结期间，流体压靠于其上的力而实施从容器移开。

另外，根据本发明的较优实施例，设置了加热元件的电源切断装置。

根据本发明的较优实施例，电源切断装置包括熔丝，它电连接至加热元件。

此外，根据本发明的较优实施例，熔丝位于容器之内，并与容器中的清洗流体相接触。

再有，根据本发明的较优实施例，熔丝包括一个主体，盖部分在焊接连接处被焊接至主体上，该盖部分受偏压装置的偏压，该熔丝通

过焊接连接电连接至加热元件，其特征在于，当达到预定温度时，焊接连接由于至少其部分熔化而变弱，偏压装置将盖部分推出主体，从而引起加热元件电源的切断。

另外，根据本发明的较优实施例，熔丝安装在底座上，底座相对容器借助底盖而密封，因底盖将底座压靠在安装于容器上的 O 形圈上。

根据本发明的较优实施例，电源切断装置包括熔丝，它实际上位于加热元件之内，并电连接至加热元件。

此外，根据本发明的较优实施例，电源切断装置包括第一 FET，它与控制器进行电通信联络，熔丝位于容器之外，并在运行中与第一 FET 相连接，第二 FET 在运行中与熔丝相连接，该第二 FET 至少与温度传感器中的一个温度传感器进行通信联络，定温器安装在容器中，而逻辑线路与第二 FET 位于电通信联络之中。

根据本发明的较优实施例，如果没有命令信号从控制器输送给第一 FET，第一 FET 开路，而加热元件未被激励。如果命令信号从控制器输送给第一 FET，第一 FET 闭合，加热元件被激励。如果没有命令信号从控制器输送给第一 FET，但跨越第一 FET 存在一个近乎零的电压降，于是第二 FET 被命令闭合，从而通过熔丝输送电流，它断开熔丝，并切断加热元件的电源。如果命令信号从控制器输送给第一 FET，但跨越第一 FET 存在一个一般大于零的电压降，于是机动车车窗的清洗或去冰装置被命令停止运行。

此外，根据本发明的较优实施例，一个螺线管与安装在容器内的控制线路印刷电路板(PCB)进行直接电通信联络，螺线管确定，流体是直接流至喷雾头，或通过容器流至该喷雾头。螺线管最好装备至 PCB 上。

根据本发明的较优实施例，PCB 可有选择地连接至机动车的计算机，其特征在于，螺线管及机动车车窗的清洗或去冰装置的运行可至少由 PCB 与机动车的计算机中之一加以控制。

由本发明较优实施例的以下详细说明，并结合附图，可对本发明

进行更充分的了解，其中：

图 1 是一张示意性图片，它展示了根据本发明较优实施例提出的应用加热的清洗流体对汽车的挡风玻璃进行清洗的装置；

图 2 是一张示意性框图，它展示了根据本发明较优实施例提出的图 1 中清洗装置的细节；

图 3 是一张简化示图，它展示了在图 2 的车窗的去冰和清洗装置中使用的充装和泄水泵送系统，该泵送系统根据本发明的较优实施例加以建造和进行运行；

图 4 是一张简化示图，它展示了在图 2 的车窗的去冰和清洗装置中使用的充装和泄水泵送系统，该泵送系统根据本发明的较优实施例加以建造和进行运行；

图 5 是一张定时框图，它展示了按本发明较优实施例提出的图 1 的装置的运行；

图 6 是一张简化示图，它展示了按本发明较优实施例建造和运行的多出口喷雾头；

图 7 是一张简化示图，它展示了按本发明较优实施例建造和运行的多出口喷雾头；

图 8 和 9 是简化示图，它们展示了按本发明较优实施例建造和运行的挡风玻璃雨刷驱动器系统，其中图 8 展示夏季停车模式，而图 9 展示冬季停车模式；

图 10 是图 8 和 9 中的挡风玻璃雨刷驱动器系统的简化方框图；

图 11A-11F 是按本发明较优实施例提出的，图 8 和 9 的挡风玻璃雨刷驱动器系统的典型操作系列；

图 12 是按本发明较优实施例提出的凸轮系统的简示图，用于控制图 11A-11F 中的挡风玻璃雨刷驱动器系统的操作系列期间的喷雾头；

图 13 和 14 是按本发明较优实施例建造和运行的挡风玻璃雨刷的相应简化透视图和截面视图，图 14 沿图 13 中直线 XIV-XIV 截取；

图 15 是药夹的简化局部截面图，药夹包含添加剂，该添加剂能被添加至在按本发明较优实施例建造的挡风玻璃清洗装置中应用的流体

中，其中药夹安装在系统中，而添加剂与流体一起流入溶液中；

图 16 是图 15 的药夹的简化透视图；

图 17 是用于承放若干此类药夹的简化透视图；

图 18 是一个简化、局部截面图，它展示一种流体核定系统，用于检查被核定流体在按本发明较优实施例建造的图 1 中挡风玻璃雨刷清洗装置内的应用；

图 19A 和 19B 是简化、局部截面图，它们展示按本发明较优实施例建造的螺线管，该螺线管用于本发明的挡风玻璃雨刷清洗装置中，图 19B 沿图 19A 的直线 19B-19B 截取；

图 20 是一个简化、局部截面图，它展示一种用以防止由于流体在按本发明较优实施例建造的图 1 中挡风玻璃雨刷清洗装置内冻结引起损坏的装置；

图 21 是一个简化图，它展示按本发明较优实施例建造的图 1 中挡风玻璃雨刷清洗装置的电源切断装置，用于防止由于过热可能引起的损坏；

图 22 是一个简化图，它展示图 21 中的装置与图 1 中挡风玻璃雨刷清洗装置组装在一起时的组装图；

图 23 是一个简化截面图，它展示按本发明另一较优实施例建造的图 1 中挡风玻璃雨刷清洗装置的电源切断装置，用于防止由于过热可能引起的损坏；

图 24 是一个简化截面图，它展示按本发明又另一较优实施例建造的图 1 中挡风玻璃雨刷清洗装置的电源切断装置，用于防止由于过热可能引起的损坏；

图 25 是一个简化方框图，它展示按本发明又另一较优实施例建造的图 1 中挡风玻璃雨刷清洗装置的电源切断装置，用于防止由于过热可能引起的损坏；

图 26-29 是简化截面图，它们展示应用在按本发明另一较优实施例建造的挡风玻璃雨刷清洗装置中的螺线管。

现请参看图 1，它是一个示意性图片展示，表示根据本发明较优

实施例提出的电力供能的机动车车窗的去冰及清洗装置 20，装置 20 以组装形式用于汽车 22 中，汽车 22 具有被冰 26 覆盖的挡风玻璃 24。

挡风玻璃清洗流体的加热容器 28 连接在汽车 22 的清洗流体贮槽 30 与喷雾头 32 之间，喷雾头 32 当被汽车的操作人 25 启动时将流体喷雾在挡风玻璃 24 上。操作人可或由汽车 22 的内侧，或由汽车 22 的外侧，诸如如图 1 所示，下文将进一步描述的，借助遥控器 90 启动装置。容器 28 具有入口端口 34，它接收来自贮槽 30 的清洗流体；以及出口端口 36，加热流体通过它排至喷雾头 32。流体由泵 40 加以驱动，泵 40 通常已存在于汽车 22 中，用于对未加热流体进行喷雾以清洗挡风玻璃 24。电池 42 向装置 20 提供电源，而雨刷 44 如本领域已知的从挡风玻璃上清除融化的冰及污垢。控制器 46 控制装置 20 的运行，可任选的是还能控制连同装置一起运行的雨刷 44。装置 20 的其他方面和细节将在下文进一步加以描述。

现请参看图 2，它表示按本发明较优实施例提出的装置 20 的容器 28 及其它部件的细节。容器 28 通常为圆柱形形状，并包括由外腔室 54 包围的内腔室 52。内腔室 52 由内壁 56 容纳和限定，内壁 56 最好由诸如不锈钢的金属制成。外腔室 54 被容器的外壁 58 所围绕，外壁最好由诸如塑料的绝缘材料制成。加热元件 50 位于内腔室 52 的内侧，加热容器 28 内的流体。由于腔室 52 和 54 同轴地布置，从容器 28 传出的热损失达到最小，因为由腔室 52 中的热流体给出的热损失大部分被用于预热腔室 54 中较冷的流体。由于腔室 54 中的流体较冷，因此其通过外壁 58 的热损失也较小。

加热元件 50 最好包括电阻性加热的电元件，它由电池 42 借助控制器 46 根据下文将进一步描述的加热次序供电。替而代之或在此之外，元件 50 可通过与诸如发动机冷却流体或废气的汽车 22 中的热源的热交换而加热。但是，由电池 42 进行的电加热是有优越性的，因为它使容器 28 得以甚至在汽车启动之前就快速地加热。元件 50 最好提取约 400 瓦，一般的汽车电池能容易地供应它。此外，容器 28 的尺寸最好是，在开动的约一分钟或更少的时间内，它能加热和排出一个容

积的流体，其温度足以融化冰 26。为此目的，内腔室 52 最好包含约 50ml 的流体。但是，需要明白的是，本发明的这些原理通过容器 28 的容积与元件 50 的功率的按比例换算，同样可适用于任何要求的容量。特别是，当装置 20 用于诸如卡车或船只的较大机动车时，容器的容积和功率提取通常将显著大于在汽车 22 中的。

初始量的加热流体被排出后，泵 40 和入口阀 66 动作以重新充装容器 28。虽然加热元件 50 和壁 56 不再像初始量的流体输入容器前那样的热，它们仍保留一定的残余热量，促进重新充装的流体快速加热。当重新充入的流体达到要求温度，最好加热元件 50 达到几百℃的温度时，和/或预定时间间隔后，它通过喷雾头 32 排出。此过程依次重复要求的次数，直至如下文所述地，整个喷射系列已完成，或直至挡风玻璃被洗净和/或去净冰，或直至容器 28 中的温度降至预定最低温度以下，或直至操作人 25 打断它。于是驾车人可再次启动装置 20，开始新一轮的流体加热和排放。

最好加热流体在约 3 秒钟内通过喷雾头 32 而排出，而每次容器 28 在两次充装之间的再充装间隔约为 5 秒或更长，这通常取决于流体达到诸如 80-100℃的要求温度所需的时间。在排放系列中，稍后排放的温度可能低于初始及其它稍早排放的温度。此外，雨刷 44 最好协同流体从装置 20 的排出一起运行，从而雨刷 44 只在流体排放期间和在其后不久进行。可任选的是，雨刷的运行可加以延迟，这样，雨刷不是在冰 26 尚未融化的初始排放期间运行，而只是从第二次及其后的排放开始。

加热流体排放系列完成后，阀 66 关闭(相对容器 28)，而泄水阀 62 最好打开，从而任何残留在容器内的流体能泄入排回至贮槽 30 中。泵 40 一般不为阻挡反流而密封。因此最好设置卸压阀 73 以卸去在此情况下建立的任何流体压力。卸压阀 73 使流体得以在过压情况流回贮槽 30。泄水端口 60 的上端 61 最好相对腔室 52 的底部而升高，从而即使在泄水之后仍有最少量的流体留在容器 28 内。于是容器准备好在下一次装置 20 被启动时快速运行。

旁通管线 76 使未加热的流体得以从贮槽 30 直接泵送至喷雾头 32，无需通过容器 28。管线 76 每当阀 74，最好是三通阀，相对出口端口 36 关闭时，就向着喷雾头 32 打开。管线 76 能在气候暖和，不需去冰时应用，或在立即需要清洗喷雾、没有时间加热流体时应用。阀 74 最好相对管线 76 而打开，从而每当加热装置不启动时，流体就从管线传送至喷雾头 32。在管线 76 中的单通阀 80 最好阻断任何流体反流通过管线。

这样，装置 20 就具有附加的汽车 22 的车窗清洗功能，其成本较低，且不干扰先前存在的车窗清洗能力。装置或可作为新汽车中车窗清洗系统的一部分加以安装，或可方便地改装在已有的清洗系统中。虽然图 1 和 2 所示的装置 20 的零件位于相对汽车 22 及其中清洗系统的某些位置和定向，但其它位置和定向显然也是可能的。例如，容器 28 可放置在与图中所示定向成不同的角度上，只要端口 34、36 和 60 适当地放置和定位在容器中。

在上文被描述的控制器 46 对装置 20 的控制是基于由传感器 64 提供给控制器的反馈。图 2 所示的此传感器被放置在容器 28 的上端，在此处，根据腔室是空的或是充满的，它或将测量腔室 52 中蒸汽的温度，或将测量腔室 52 中流体的温度。控制器 46 最好追踪和监视容器 28 的加热/充装/排放循环期间传感器 64 检测到的温度改变。如果温度超过预定最高值，或者温度变化不按照预定的正常剖面，则控制器将断定已产生出错，诸如入口 34 或出口 36 的阻塞，或传感器 64 失效，最好将中断装置的运行，并通过适当信号通知操作人 25。

在传感器 64 之外或作为替代物，可在较靠近容器 28 的底部设置温度传感器 301，用以测量此处的流体温度，或在加热元件 50 内、上或附近安装温度传感器 302。其它传感器，诸如压力传感器或定压器，或流体水平传感器 303，也可固定在容器中，向控制器 46 提供反馈。还可应用另一些温度传感器，包括在容器 28 外表面上的传感器 82、在贮槽 30 内用于测量其中流体温度的传感器 84、以及在汽车 22 的外表面上，最好在挡风玻璃 24 上的传感器 86。这些传感器向控制器 46

提供输入，控制器 46 相应设置参数，诸如施加于元件 50 的电压和/或容器 28 内元件和流体加热的时间长度。

控制器最好将参数设置成，喷雾在挡风玻璃 24 上的流体的温度高得足以在例如由传感器 86 指示的占优势的四周条件下快速融化冰 26，但又不是如此之高(相对挡风玻璃的温度)，以致有造成挡风玻璃破裂的危险，或有破坏这方面的安全条例的危险。参数的选择最好是自动的，不要求汽车 22 的操作人 25 的干预，除去按要求启动或消动装置 20 外。

上述说明是披露于 PCT 申请 PCT/US98/13023 中的装置的说明。现将说明此装置的改进，首先参看图 2。

在传感器 64 之外或作为替代物，最好在每一喷雾头 32 上或附近安装温度传感器 304。温度传感器 304 可额外地安装在喷雾头的 T 型连接 305 上。喷雾头 32 的温度输入给控制器 46，提供设置参数用的进一步反馈控制，这些参数包括诸如施加至元件 50 的电压，和/或元件及流体在容器 28 内的加热时间的长度。

容器 28 的初始加热期间，如上文所述及如图 2 所示，一般有少量流体存留于其中。可看到，对于这样少量的流体，加热元件 50 可能不浸没在流体中，而是其大部分长度暴露至容器 28 内侧的空气中。在此情况，给加热元件 50 通电可能是浪费的且是有害的，因为这可能引起由于过热造成的破坏。为解决这一问题，最好在容器 28 的底部设置辅助加热元件 306。加热元件 306 可成形成例如线圈加热器，或任何其它合适的低剖面形状。

加热元件 306 如现在描述的，最好连接至控制器 46，并由控制器 46 加以控制。如果容器 28 内的流体量足以覆盖加热元件 306，但不能覆盖大部分加热元件 50，则加热元件 306 将花费较短的时间，以便将流体加热至预定温度，诸如沸点。但是，如果容器 28 内的流体量足以将加热元件 50 和 306 均加以覆盖，则加热元件 306 将花费较长时间以便将流体加热至预定温度。温度传感器 301 和 302，以及流体水平传感器 303 和 309 或任何其它安装在容器 28 内的任选传感器可用于监控

预定温升所需的时间，该时间由控制器 46 加以处理以便控制加热元件 50 和 306 的加热。例如，如果受监控的时间较短，即低于预定阈值，控制器 46 将此理解为流体只覆盖加热元件 306，从而只对加热元件 306 通电，而不对加热元件 50 通电。如果时间等于或超过预定阈值，则控制器 46 将此理解为流体足以将加热元件 50 和 306 均加以覆盖，从而对加热元件 50 和 306 均通以电流。

如上所述，所叙述的控制器 46 对装置 20 的控制是基于传感器 64 向控制器提供的反馈。当控制系统中有故障时，作为一个附加的安全特征，可在容器 28 的上端设置一个与控制器不相连的热开关 308，根据腔室是空的或是充满的，热开关 308 监控腔室 52 内的蒸汽或流体的温度。如果温度超过预定最高值，热开关 308 就独立地停止装置的运行，即使在机动车或装置 20 的电系统中有故障时也如此，且可任选的是，可应用适当的信号通知操作人 25。

现请参看图 3，它展示了充装和泄水泵送系统 310，该系统 310 对车窗的去冰及清洗装置 20 有用，并按本发明的较优实施例加以建造和运行。在图 3 的实施例中，系统 310 最好应用上述的泵 40。泵 40 最好是离心式水泵，这意味着，它是一台不可逆的泵，即流体通常从入口 40A 流向出口 40B。

根据本发明的较优实施例，第一螺线管 312 位于泵 40 的入口 40A 与贮槽 30 之间的流体联通处。螺线管 312 的接口端口 314 最好通过流体管线 312 连接至贮槽 30，而出口端口 315 最好通过流体管线 326 和 T 形接头 316 连接至入口 40A。同样，第二螺线管 318 最好位于泵 40 的出口 40B 与容器 28 的流体联通处。螺线管 318 的接口端口 320 最好通过流体管线 328 和 T 形接头 330 连接至入口端口 34。螺线管 318 的另一端口 319 最好通过 T 形接头 322 和流体管线 327 连接至出口 40B。

在螺线管 312 的正常打开位置，端口 315 是开的，而第三端口 340 是关的。同样，在螺线管 318 的正常打开位置，端口 319 是开的，而第三端口 336 是关的。相反，在螺线管 312 的关闭位置，端口 315 是

关的，而第三端口 340 是开的，在螺线管 318 的关闭位置，端口 319 是关的，而第三端口 336 是开的。螺线管 312 和 318 以及系统 310 的其它部件的控制最好借助控制器 46 来完成。根据本发明的较优实施例，螺线管 312 和 318 可如图 19A 和 19B 所示地加以建造，并在下文将参照图 19A 和 19B 加以叙述。

泵送系统 310 用于当螺线管最好处于正常打开位置时对容器 28 进行充装。泵 40 进行运行，用以将流体从贮槽 30 通过流体管线 324(沿图 3 中的实线方向)抽至螺线管 312。流体进入端口 314、流出开的端口 315、通过流体管线 326、流过 T 形接头 316、流至泵 40 的入口 40A。需指出的是，流体不会从 T 形接头 316 流向螺线管 318，因为端口 336 是关闭的。流体从泵 40 的出口 40B 通过 T 形接头 322、借道流体管线 327 流向螺线管 318 的开的端口 319。流体通过端口 320 和流体管线 328(沿图 3 中的实线方向)离开螺线管 318 而流至 T 形接头 330。

容器 28 最好装备有单通阀 334，它使流体只能从泄水端口 60 流出。因此，流体只能从 T 形接头 330 流至入口端口 34，它最好包括一个阀(文中也称为阀 34)。阀 34 由控制器 46 打开，流体充入容器 28。

当要求将流体从容器 28 中泄出时，螺线管被激励至关闭位置。泵 40 的泵送作用引起流体从泄水端口 60 排出，并通过单通阀 334 流至 T 形接头 330。阀 34 被控制器 46 关闭，从而流体被迫在流体管线 328(沿图 3 中的虚线方向)流至螺线管 318 的端口 320。由于端口 319 是关闭的，流体从螺线管 318 的端口 336 流出，通过流体管线 338 流至 T 形接头 316(沿图 3 中的虚线方向)。由于螺线管 312 的端口 315 是关闭的，流体只能从 T 形接头 316 流至泵 40 的入口 40A。流体离开泵 40 的出口 40B，流至 T 形接头 322。由于螺线管 318 的端口 319 是关闭的，流体只能从 T 形接头 322 流至螺线管 312 的端口 340(沿图 3 中的虚线方向)。然后，流体离开螺线管 312 的端口 314 返回至贮槽 30(沿图 3 中的虚线方向)，于是泄水完成。

现参看图 4，它展示了充装和泄水泵送系统 350，该系统 350 对车窗的去冰及清洗装置 20 有用，并按本发明的另一较优实施例加以建造

和运行。泵送系统 350 的结构与泵送系统 310 的相似，其中相同的部件用相同的数字表示(为简单起见，卸压泵 73 及其它部件未加表示)。泵送系统 350 与系统 310 的不同在于，在系统 350 中更可取地应用了诸如齿轮泵的可逆泵 352，即流体在第一端口 352A 和第二端口 352B 均能流入和流出。此外，在泵送系统 350 中不需螺线管。

当要求将流体充入容器 28 时，泵 352 进行这样的运行，以使流体沿箭头 356 的方向被泵送。流体从贮槽 30 借助流体管线 324 流过泵 352，由此通过流体管线 328 流至 T 形接头 330，最后通过打开的阀 34 进入和充装容器 28，因为流体不能流动通过单通阀 334。

当要求将流体从容器 28 中泄出时，泵 352 的泵送方向逆向，从而现在泵 352 在箭头 354 的方向泵送流体。流体从泄水端口 60 泄出，通过单通阀 334 流至 T 形接头 330。阀 34 是关闭的，从而流体被迫在流体管线 328 中流回至泵 352，由此返回至贮槽 30，于是泄水完成。

现请参看图 5，这是一个定时图表，它展示了按本发明较优实施例提出的装置 20 的加热/充装/排放循环的系列 96。所应用的泵送系统可以是图 4 的可逆泵送系统。在此情况，泵送系统可将流体泵向容器 28(在图表中用正的纵坐标表示)，或它可将流体从容器 28 泄出(在图表中用负的纵坐标表示)。要指出的是，泵 352 在需要时可间歇地加以驱动，或替而代之，泵 352 可连续地加以驱动，而控制器 46 可用于按需要将泵 352 在充装模式或泄水模式之间进行转接。

如上文所述，一开始泄水阀 62 打开，而加热元件 306 和/或加热元件 50 被激励以预热容器 28。阀 62 最好在约 15sec 后关闭。可替而代之的是，泄水阀可保持一个短间隔的关闭，最好约 20sec，这样，在阀被打开之前，流体在容器 28 中加热至高温。此替代方法在以下情况特别有用，即如果控制器 46 确定阀中有一个阀，特别是入口阀 66 是堵塞的，不能打开，这时，加热流体就被用于迫使阀打开。

加热持续至传感器 64 或 301 达到腔室 52 中的目标温度，最好约 85℃ (随传感器的严格位置不同而不同)，或约加热 70sec，如果温度未达到目标温度的话。此时，泵 40 以及入口和出口阀 66 和 74 打开，

允许初始流体量得以排出。腔室 52 中的温度下降，然后重新加热，最好加至约 60℃，于是允许第二次流体量得以排出。再加热、充装和排放的过程持续预定的循环量，或直至被操作人 25 终止。

系列 96 中的最后一次排放后，泄水阀 62 打开，而在系列全过程中基本连续激励的加热元件 50 和/或 306 则再保持多激励约 15sec，以便加热残留于容器 28 中的流体，尽可能多地将其从容器 28 中排出，使其下降至上端部 61 的水平。于是装置准备好在使用者需要时，开始下一个系列。最为可取的是，如由图 5 可见，加热元件 306 在加热元件 50 激励之前首先激励，最好在加热元件 50 激励之前有约 2－10sec 的延迟。同样，最为可取的是，加热元件 50 在循环结束时的断开要早于加热元件 306。加热元件 50 和 306 之间在循环开始与结束时的延迟是工作循环的最可取的部分，从而得以阻止加热元件 50 的过热，确保存留在容器 28 底部的流体量的适当初始加热。

在参照图 5 叙述的运行模式中，冷流体可能在喷雾头的方向存留在流体管线中。这是不符合要求的，因为最开始喷雾在挡风玻璃上的流体将是冷的，只有在这之后加热流体将到达挡风玻璃。与结合图 5 描述的运行模式相反，可采用不同的运行模式以便防止这一现象。泵送系统可停止，而流体仍在流向容器 28(由于惯性运动)，且只有在延迟之后，可借助阀，将流体从向着容器 28 的方向重新改道至向着喷雾头的方向。应用此方法，任何可能剩留在流体管线内的冷流体只会流入容器 28，而不会流向喷雾头。

现请参看图 6，它展示了一种按本发明较优实施例建造和操作的多出口喷雾头 360。多出口喷雾头 360 最好包含若干出口，诸如一个中心出口 362 及 2 个外出口 364 和 366，虽然也可应用任何数目的出口。在图 6 的实施例中，较可取的是流体借助螺线管 368 送入出口。螺线管 368 具有一个入口 382，流体能从加压流体源流入入口 382。流体最好从出口 372 离开螺线管 368，并借助 T 形接头 374 流至喷雾头出口 364 和 366。流体最好直接从加压流体源通过 T 形连接送至中心出口 362。

在螺线管 368 的正常打开位置，端口 372 是开的，而第三端口 378 是关的。相反，在螺线管 368 的关闭位置，端口 372 关闭，第三端口 378 打开。但是，在图 6 的实施例中，第三出口 378 被塞住，没有使用。

在图 6 的实施例中，来自喷雾头 360 的流体流动可借助诸如控制器 46 的控制，以便以各种形式从出口向外喷雾。例如，控制器 46 能将螺线管 368 激励至关闭位置，从而流体在初始时刻只从中心出口 362 喷出，而没有流体在初始时刻从出口 364 和 366 喷出。某个初始延迟后，螺线管 368 能打开，因而流体从出口 364 和 366 喷出，且流体基本上同时从这两个出口喷出。然后控制器 46 能继续从出口 362，以及出口 364 和 366 向外喷雾，或产生任何型式的从这三个出口喷出的间歇和连续喷雾的组合。要指出的是，在图 6 的实施例中，出口 364 和 366 总是一起喷射的。

现请参看图 7，它展示了一个根据本发明另一较优实施例建造和运行的多出口喷雾头 360，其中没有 T 形接头 374。端口 372 供应喷雾头出口 364，而第三端口 378 供应喷雾头出口 366。

在图 7 的实施例中，来自喷雾头 360 的流体流动可借助诸如控制器 46 的控制，以便以各种形式从出口向外喷雾。例如，控制器 46 可关闭螺线管 368，从而流体在初始时刻从中心出口 362 和出口 366 喷出，而没有流体喷出出口 364。某个初始延迟后，螺线管 368 可被打开，因而流体从中心出口 362 和出口 364 喷出，而没有流体从出口 366 喷出。也可能将螺线管 368 置于部分打开位置，其中流体能从两个出口 364 和 366，还有中心出口 362 喷出。图 6 和 7 所示实施例之间的差异在于，在图 6 的实施例中，出口 364 和 366 总是一起喷射的，而在图 7 的实施例中，出口 364 和 366 相互独立地喷射。这样可看到，一般讲，图 7 的实施例可比图 6 的实施例有更多种类的喷雾形式。

现请参看图 8 和 9，它们展示了根据本发明较优实施例建造和运行的挡风玻璃雨刷驱动器系统 400。挡风玻璃雨刷驱动器系统 400 能将挡风玻璃雨刷 402 和 404 或置于夏季停车模式(图 8)，或置于冬季

停车模式(图 9)。

挡风玻璃雨刷驱动器系统 400 可取地包含马达 406，马达 406 借助枢轴转动地连接至连杆臂 410 的杆 408 连接至雨刷，连杆臂 410 又借助连杆构件 412 和 414 相应地枢轴转动地连接至雨刷 402 和 404。连杆构件 412 和 414 的行程极限用幻象线示于图 8 和 9 中。可看到，最好设置传感器，以便检测行程极限。例如，在所示实施例中，设置了一对微型开关 416 和 418。在夏季停车模式，雨刷 402 和 404 被置于水平或近于水平位置，马达 406 的触头 420 驱动微型开关 416。在冬季停车模式，雨刷 402 和 404 被置于非水平位置，可能甚至于竖直位置，触头 420 驱动微型开关 418。要清楚的是，可应用其它传感器以替代微型开关，诸如霍尔效应传感器，用以检测行程的极限。

在夏季停车模式，雨刷静止于水平或近乎水平位置，因为在夏季通常没有冰。但是，在冬季，如果形成了冰，雨刷可能粘至挡风玻璃上，或即使不粘住，形成的冰会阻碍雨刷的运动。如果雨刷在初始时位于水平位置，则在去冰开始时，雨刷只能在挡风玻璃的底部部分开始运动，初始清除的挡风玻璃面积仍不能为安全驾驶提供一个适当的可视面积。驾驶人必须等待，直至去冰装置已融化足够量的冰，使雨刷能摆动向上，以便为安全驾驶在挡风玻璃上清除出一个可视刈幅。将雨刷置于非水平的冬季停车模式，在去冰过程的开始时刻，挡风玻璃上初始清除的区域就已经能为安全驶驾提供一个适当的可视区域。

要指出的是，在图 9 中清洗机流体(标号为 407)是从雨刷 402 和 404 本身喷出的，这样的实施例将于下文结合图 13 和 14 加以展示和说明。

现请参看图 10，它展示了挡风玻璃雨刷驱动器系统 400 的简化框图。马达 406 最好由雨刷控制器 422 加以控制，雨刷控制器 422 最好通过功率驱动器 424 驱动马达 406。微型开关 416 和 418 最好与控制器 422 进行电联结。温度传感器 64 或 304 最好也与控制器 422 进行电联结。最好设置轴编码器 426，它能检测马达 406 的旋转，从而也能检测雨刷的旋转。轴编码器 426 还能对雨刷运行期间马达 406 的脉

冲数进行计数，其重要性将在下文进一步说明。

另一些传感器的实例是可向控制器 46 提供数据以便控制加热元件 50 和 306 的加热的传感器，它们是风速传感器 57 和机动车速度传感器 59，后者最好是与机动车测速计一起使用的标准速度传感器。风在其到达挡风玻璃之前能冷却流体。因此，控制器 46 能将风速换算成对流体温度的热效应，并为此在流体喷射至挡风玻璃上之前通过将流体加热至较高的温度而进行补偿。可替而代之的是，如果没有明显的风，则控制器 46 可节省电能，将流体加热至稍微低一些的温度。

驾驶人能手动地将挡风玻璃雨刷驱动器系统 400 置于冬季停车模式。可替而代之是，系统 400 可自动地加以驱动。例如，温度传感器 64 或 304，或者在机动车外侧的温度传感器可用于检测夜间的温降，然后此检测到的温度改变被控制器 422 所解释，用以将挡风玻璃雨刷置于冬季停车模式。

如上所述，当有冰形成时，雨刷可能粘至挡风玻璃上，或即使不粘住，则形成的冰会阻碍雨刷的运动。在此初始阶段，马达 406 被要求产生大的扭矩量，可能变得过热或损坏。因此，重要的是要阻止这种对马达 406 的损害。这可用若干种方法来完成。例如，轴编码器 426 或马达 406 的换向系统可用于对雨刷运行期间马达 406 的脉冲数进行计数。控制器 422 能将此脉冲数与预定数进行比较，用以解释马达 406 是否过度使用。如果马达 406 是过度使用，于是控制器 422 可停止马达 406 的运行，以防止对此的损坏。

作为另一实例是，由于控制器 422 发给驱动器 424 的电信号一般正比于驱动器 424 输入给马达 406 的电流输出，因此，驱动器 424 的输出电流的过度上升可用于指示马达 406 的过热。在此情况，当然，轴编码器 426 就不再需要了。

作为又一实例是，微型开关 416 和 418 的激励或非激励给控制器 46 和 422 提供了雨刷 402 和 404 的顺时针或逆时针运动的指示。通过简单地检测，哪一个微型开关先于另一个被激励，则控制器 46 和 422 能分辨雨刷运动的方向。即使对于雨刷的微小运动，其中只有一个微

型开关可被激励，控制器 46 和 422 仍旧能检测雨刷运动的方向。特定微型开关被激励的次数，或替而代之，马达 406 的脉冲数能指示雨刷的运动。此外，微型开关 416 和 418 能用于监控马达 406 的任何可能的过载，而无需轴编码器 426 或甚至驱动器 424。例如，马达 406 的触头 420 最初与微型开关 416 接触。如果雨刷的运动没有障碍，则马达 406 将开始旋转，微型开关 416 将被松开。但是，如果存在雨刷运动的障碍，则马达 406 会停住少许，且微型开关 416 不被松开。于是，控制器 422 能解释微型开关 416 的松开或不松开，用以检测和阻止马达 406 的过热。

现请参看图 11A—11F，它们展示了按本发明较优实施例提出的挡风玻璃雨刷驱动器系统 400 的典型运行系列。在随后的说明中，流体从喷雾头 360 喷出(图 7)，但应理解，其它喷雾头也可应用。

在图 11A 中，雨刷 402 和 404 处于冬季停车模式，从而放置在某个非水平位置。喷雾头 360 的中心出口 362 和出口 364 将流体喷于区域 430 和 432，以便开始融化积聚在挡风玻璃上的冰。马达 406 试图在箭头 434 指示的顺时针方向摆动雨刷。在预定的时间间隔内，诸如 0.5sec，测量马达 406 的扭矩。如果扭矩达到某个预定值，控制器 422 停止马达 406 运行。

在图 11B 中，喷雾头 360 的中心出口 362 和出口 364 继续将流体喷在区域 430 和 432 上。马达 406 试图在箭头 436 指示的逆时针方向摆动雨刷。再次在预定的时间间隔内测量马达 406 的扭矩，如果扭矩达到某个预定值，控制器 422 停止马达 406 运行。

在图 11C 中，喷雾头 360 的中心出口 362 和出口 364 继续将流体喷在区域 430 和 432。这一次，流体成功地融化了某些冰。马达 406 现在得以在顺时针和逆时针两个方向(箭头 434 和 436)摆动雨刷。当马达 406 的扭矩达到某一预定水平，控制器 422 将雨刷的摆动方向从顺时针转换至逆时针，或反之。

在图 11D 中，出口 366 开始将流体喷在区域 438，而出口 364 暂时停止运行。中心出口 362 继续喷雾流体。现在马达 406 试图在逆时

针方向摆动雨刷，从而开始清除挡风玻璃上，另一幅刈幅。应明白的是，可替代的是，出口 364 可保持打开，以便将流体继续喷在挡风玻璃上。还要明白的是，在清洗挡风玻璃和去除其上的冰时，可应用各种喷雾形式，上述形式只是这些可能性中的一种。

在图 11E 中，雨刷的刈幅已增大，更多的挡风玻璃已干净。在图 11F 中，流体已成功地融化了冰，雨刷能自由地横越挡风玻璃而摆动。

如上所述，喷雾头 360 可取地由控制器 46 加以控制。但喷雾头的控制可以以任何合适的方式加以完成，例如，电子的或机械的。现在将说明一种喷雾头新颖控制方法的实例。

现请参看图 12，它展示了一种凸轮系统 440，用于在按本发明较优实施例提出的挡风玻璃雨刷驱动器系统 400 的运行系列期间控制喷雾头 360。在凸轮系统 440 中，出口 362、364 和 366 最好由单个阀 442、444 和 446 分别加以控制。阀可例如是电子阀或螺线管阀。阀相应地装备有推杆 448、450 和 452，这些推杆由连接至雨刷 402 或 404 的凸轮 454 驱动。

凸轮 454 的凸轮表面根据要求的喷雾形式加以设计。例如，如图 12 所示，凸轮 454 可向下推压在杆 448 和 450 上，用以驱动阀 442 和 444，得以从出口 362 和 364 向外喷雾，而杆 452 在初始时刻是不被凸轮 454 向下推压的，因此出口 366 在初始时刻是关闭的。由于雨刷 402 或 404 在逆时针方向摆动，凸轮 454 向下推压在杆 452 上，并打开出口 366，以便由此通过进行喷雾，而出口 362 和 364 则总是保持打开。要明白的是，可在挡风玻璃的清洗和去冰中应用各种喷雾形式，上述形式只是这些可能性中的一种。

现请参看图 13 和 14，它们展示了按本发明的较优实施例建造和运行的挡风玻璃雨刷 460。挡风玻璃雨刷 460 可取地具有纵向孔 462，它成形成由此贯通，以便流体通过此处而流动。孔 462 与若干出口孔 464 进行流体的联通，用以将流体喷在挡风玻璃上。刮刀 466 从雨刷 460 的主体 468 向外伸展，用于清洁挡风玻璃。流体最好在雨刷 460 的一端 470 进入孔 462 中，而相对端 472 是基本密封的。

现请参看图 15 和 16，它们展示了在诸如图 1 中的本发明的挡风玻璃雨刷清洗装置中有用的药夹 480，此药夹 480 按本发明的较优实施例加以建造。在本发明的挡风玻璃雨刷清洗装置中应用的流体是任何一种合适的挡风玻璃清洗机流体，以及诸如可包含例如如防冻液的添加剂的流体。药夹 480 是一种适宜将这样一种添加剂添加至挡风玻璃清洗机流体中的装置。

请参看图 16，药夹 480 包含添加剂 482。药夹 480 可由任何合适的材料，诸如塑料或金属制成，添加剂 482 可是液体或固体。当为固体形状时，药夹 480 本身就可是添加剂的固体块。药夹 480 装配在穿孔的容器 484 中，容器 484 由塞子 486 加以封口。塞子 486 最好密封压紧地装配穿孔容器 484 中，并设置有螺纹颈 488。在螺纹颈 488 之下是成形有若干穿孔 487 的颈部分 485。孔 487 与中心孔 483 进行流体联通，中心孔 483 又与穿孔容器 484 进行流体联通。

现请参看图 15，可看到，螺纹颈 488 可拧入至容器 490 中，并最好由 O 形圈 491 加以密封。容器 490 具有流体入口 492 和流体出口 494。流体可诸如从贮槽 30(图 2)进入入口 492，并通过孔 487 和中心孔 483 流入穿孔容器 484。药夹 480 变成浸没在流体中，而添加剂 482 通过诸如像渗滤、浸出或溶解与流体混合。于是，带有添加剂 482 的流体通过出口 494 流出，并流入容器 28。请参看图 17，可看到托架 496 可用于方便地贮存若干个药夹 480。

现请参看图 18，图 18 展示了一种流体核定系统 500，它用于检查被核定流体在图 1 的挡风玻璃雨刷清洗装置中的应用，并按本发明的较优实施例加以建造。流体核定系统 500 最好包括薄膜 502 和观察窗 504，它们两者最好均由密封件 506 加以密封，密封件 506 可诸如是 O 形圈，其形状可例如是圆形或是矩形。薄膜 502 最好由这样的材料制成，即如果它不是存在于本发明的挡风玻璃雨刷清洗装置使用的核定流体时，它就会分解。例如，添加剂 482 与水混合后可产生化学反应，它禁止薄膜 502 的解体或分解。(一个实例是，一种薄膜当存在于基础溶液中时会分解，但添加剂 482 将溶液的 pH 值改变至中性或酸性，从

而阻止薄膜分解。)如果没有应用经核定的流体，于是薄膜502的任何分解都可通过观察窗504观察到。

现请参看图19A和19B，它们展示了按本发明的较优实施例建造的，并在本发明的挡风玻璃雨刷清洗装置中有作用的螺线管510。螺线管510最好包括中心轴512,在中心轴512的远端固定着大致为倒U形的轭架514。设置了电磁装置511，用于大致线性地移动轴512。杆516最好用钉518固定地钉在轭架514上。连接至螺线管510的主体520的底部部分的是一件管状接受构件522。管状接受构件522也最好包含一对固定杆532和534，它们分别穿过成形在轭架514中的孔536和538。如由图19A和19B可见，管528放置在轭架514的杆516与固定杆532之间。管530放置在轭架514的杆516与固定杆534之间。轭架514设置在管状接受构件522的腔540内。管528和530最好由诸如橡胶或聚氯丁橡胶的弹性材料制成。弹性管从受压状态弹性回复至非受压状态对轴512作用了一个力，这进一步帮助轴512的大致为线性的移动，从而实现能量节省。

图19A展示螺线管510的正常打开位置。在此位置时，杆516挤压管530，从而基本密封管530，使流体不能由此通过。管530(以及管528)最好具有椭圆形横截面(或其它合适的非圆形横截面)以促进其变扁平。再有，此形状还能使中心轴512具有较小的移动距离，及螺线管在管上作用较大的力。在正常打开位置，管528不受挤压，流体可由此通过。

螺线管510能被激励至关闭位置。在此位置时，杆516在图19A和19B的意义上被向上移动，于是挤压管528，从而基本密封管528，流体不能由此通过。在关闭位置时，管530不受挤压，流体可由此通过。也可以将螺线管510激励至部分打开的位置，其中，流体从管528和530中都能流出。

本领域中的技术人员都清楚，如需要的话，螺线管510的结构可加以适当改变，用以只密封和打开一根管，或密封和打开两根以上管。还清楚的是，正常的打开位置和关闭位置可加以颠倒。此外，管能由

诸如 T 形接头的适当接头加以连接。

现请参看图 20，它展示了一种装置 600，该装置 600 用以防止由于流体冻结在图 1 中挡风玻璃雨刷清洗装置中而引起的破坏，并按本发明的较优实施例加以建造。装置 600 最好包含可移动平台 602，它装备在位于容器 28 的内、外腔室 52 和 54 的底部的杆 604 上。诸如螺旋弹簧的偏压装置 606 安装在杆上，并通常推动平台 602 向上。杆 604 配置成得以通过孔 607 滑移出容器 28。如果流体在内或外腔室 52 和 54 中冻结，并在冻结时膨胀，则冻结的流体将抵压平台 602 而膨胀。平台 602 将压缩偏压装置 606，并由于膨胀着的冻结流体的力而向下移动。这样，膨胀着的冻结流体就不会抵压壁 56 而膨胀，从而不会对壁 56 产生损坏。

防止由于流体冻结引起的损坏的装置的另一实例示于图 23 中。在此实施例中，盖 608 设置在容器 28 的顶部。盖 608 通常密封容器 28。如果流体在内或外腔室 52 和 54 内冻结，并在冻结时膨胀，则冻结的流体将抵撞盖 608 而膨胀。盖 608 不是紧密地固定至容器 28 上的，它能由于膨胀着的冻结流体的力而向上移动。这样，膨胀着的冻结流体简单地推出盖 608，向外和向上膨胀，而不是抵压在壁 56 上，从而对壁 56 不会产生损坏。

现参看图 21 和 22，它们展示了切断图 1 中挡风玻璃雨刷清洗装置的电源的装置，以便阻止由于过热可能产生的损坏，该装置按本发明的较优实施例进行建造。在此实施例中熔丝 610 设置成与加热元件 50 进行电连接。熔丝 610 包含一个暴露于容器 28 内流体中的部分 612。当达到预定临界温度时，超过此温度就可能对挡风玻璃雨刷清洗装置的部件产生损坏，熔丝 610 切断加热元件 50 的电源，从而防止由于过热可能引起的损坏。这样，熔丝 610 是一件保护元件，它位于容器 28 之内，并接触容器 28 内的流体。

现请参看图 23，它展示了切断图 1 中挡风玻璃雨刷清洗装置的电源的装置，以便阻止由于过热可能产生的损坏，该装置按本发明的另一较优实施例进行建造。在此实施例中，熔丝 614 设置成与加热元件

50 进行电连接。熔丝 614 包含一个主体 616，盖部分 618 在焊接连接 619 处被焊接至主体 616 上。盖部分 618 被诸如螺旋弹簧的偏压装置 620 所偏压。熔丝 614 至加热元件 50 的电连接通过焊接连接 619。

熔丝暴露于容器 28 内的流体中。当达到预定临界温度时，超过此温度就可能对挡风玻璃雨刷清洗装置的部件产生损坏，焊接连接 619 由于焊料的部分或全部熔化而变弱，偏压装置 620 将盖部分 618 推动向上，并推出主体 616，从而引起加热元件 50 的电源切断，这样就阻止了由于过热可能产生的损坏。熔丝 614 也是一件保护元件，它位于容器 28 的内部，并接触容器 28 的流体。

熔丝 614 最好安装在底座 622 上，该底座 622 相对容器 28 借助 O 形圈 624 而密封。底盖 626 拧在容器 28 的底部上，并具有一根长的中心榫舌 628，它将底座 622 压靠在 O 形圈 624 上，从而相对容器 28 形成密封连接。

现请参看图 24，它展示了切断 1 中挡风玻璃雨刷清洗装置的电源的装置，以便阻止由于过热可能产生的损坏，该装置按本发明的又另一较优实施例进行建造。在此实施例中，熔丝 630 被设置成实际上位于加热元件 50 之内，并与加热元件 50 进行电连接。加热元件 50 包括电阻丝 631，它通过导电罩套管 635 而接至地线 633。熔丝 630 可以例如是一个焊点。在达到预定临界温度时，超过此温度可能对挡风玻璃雨刷清洗装置的部件产生损坏，熔丝 630 切断加热元件 50 的电源，从而防止由于过热可能引起的损坏。

现请参看图 25，它展示了切断图 1 中挡风玻璃雨刷清洗装置的电源的装置，以便阻止由于过热可能产生的损坏，该装置按本发明的又另一较优实施例加以建造。在此实施例中，FET(场效应晶体管)632 与控制器 46 进行电通信联络，并包括如上所述的，用于控制装置 20 的运行的部分控制线路。FET 632 接受来自控制器 46 的命令电压信号。FET 632 与加热元件 50，当然还与电池 40 相连接。设置了电压传感器 633，用于检测跨越 FET 632 的触点 A 和 B 的电压降。熔丝 634 设置在容器 28 的外侧。当达到预定温度时，超过此温度可能对挡风玻璃

雨刷清洗装置的部件产生损坏，熔丝 634 切断加热元件 50 的电源，从而防止由于过热可能引起的损坏。

另一 FET 636 最好并联地连接至 FET 632 和加热元件 50。FET 636 从以下三个源之一接受命令电压信号，这三个源是：

1. 任何一个与容器 28 相关联的温度传感器，例如诸如传感器 301 和 302。

2. 定温器 638，它安装在容器 28 中(图 23)，并专用于向 FET 636 输送命令信号。

3. 逻辑线路 640，它能向 FET 636 输送命令信号。

命令信号最好通过接口线路 642 送向 FET 636。

现解释图 25 中装置的运行。如果没有命令信号从控制器 46 送至 FET 632，FET 开路，而例如如 12V 的电压降跨越 FET 632 的触点 A 和 B 而存在。这是一个正常状态，其中加热元件 50 未被激励。

如有一个例如如 5V 信号的命令信号从控制器 46 送至 FET 632，FET 632 闭合，跨越 FET 632 的触点 A 和 B 的电压降近似零。这是一个正常状态，其中加热元件 50 被激励并发热。

但是，如果没有命令信号从控制器 46 送至 FET 632，而电压传感器 633 检测到跨越 A 和 B 的电压降近乎零，于是已发生故障。被电压传感器 633 检测到的近乎零的电压降被传送至逻辑线路 640，它命令 FET 636 闭合，从而输送一个大电流通过熔丝 634，该大电流熔断熔丝 634，从而切断向加热元件 50 供应电源。这样，引起系统过热的故障被防止。

但是，如果命令信号从控制器 46 送至 FET 632，而电压传感器 633 检测到一个跨越 A 和 B 的电压降，诸如如上述的 12V，于是已发生另一类型的故障。此类型故障不危险，因为 FET 632 是开路的(因为检测到存在 12V 电压降)，加热元件 50 未被激励。但不管如何，由于系统已检测到故障，如需要，逻辑线路 640 仍可命令系统停止运行。

现参看图 26—29，这些图展示了在图 1 的挡风玻璃雨刷清洗装置中有作用的螺线管 650，它按本发明的另一较优实施例加以建造。螺

线管 650 最好包含一个与控制线路印刷电路板(PCB) 654 进行电连接的线圈 652。与单独建造的元件并被电连接至挡风玻璃雨刷清洗装置的其它螺线管不同，螺线管 650 的特征在于诸如借助硬布线或电触头直接电连接至 PCB 654，硬布线或电触头将螺线管 650 的电部件，如线圈 652，连接至 PCB 654。螺线管 650 最好借助任何适当的方法，诸如借助机械紧固件、焊接、粘接等连接至 PCB 654。螺线管 650 还包含一个入口 656 和一对出口 658 和 660。出口 658 与喷雾头进行流体联通，而出口 660 与容器 28 进行流体联通。螺线管 650 具有柱塞 662，它用于对流体通过螺线管 650 的流动进行导向。

在图 26 和 27 中，柱塞 662 放置成略微远离螺线管 650 的入口端，从而打开通道 668，将流体的流动引至出口 658。在图 28 和 29 中，柱塞 662 已移向螺线管 650 的入口端，从而基本密封通道 668，将流体的流动引至出口 660。

螺线管 650 通常由从 PCB 654 的局域控制线路 664 发出的控制信号加以控制。控制线路 664 控制泵、加热元件、高电压源等的作用。PCB 654 的另一部分，即线路 666，控制通常由机动车计算机控制的作用。通常，螺线管 650 的运行由线路 664 和 666 加以控制。可替而代之的，线路 666 可诸如借助光学链路、硬线、开关操作等连接至机动车计算机，在此情况，螺线管 650 的运行由线路 664 和机动车计算机进行控制。

将明白的是，上述较优实施例借助举例加以例述，而本发明的全部范围只由权项加以限定。

说 明 书 附 图

图 1

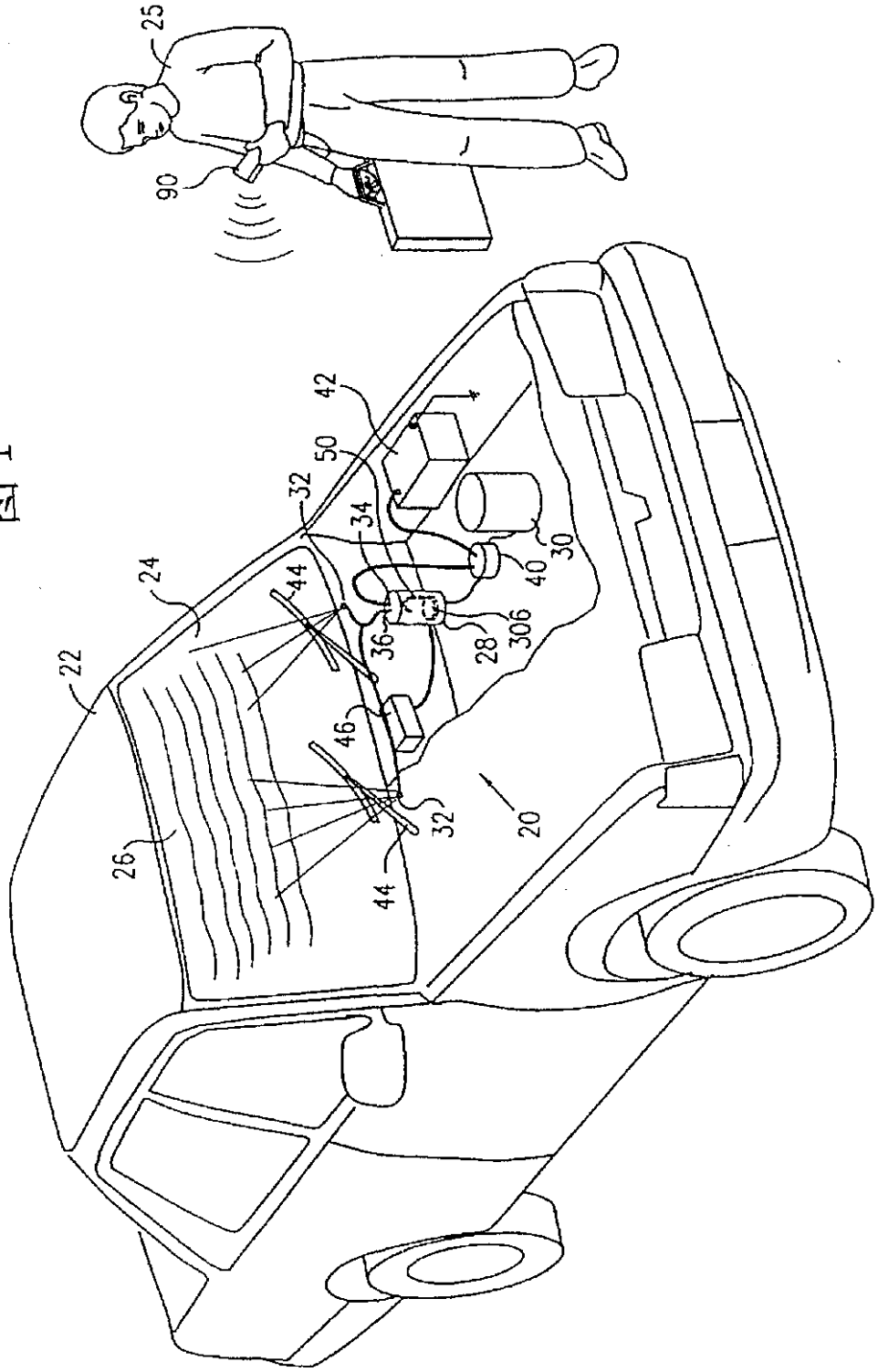


图 2

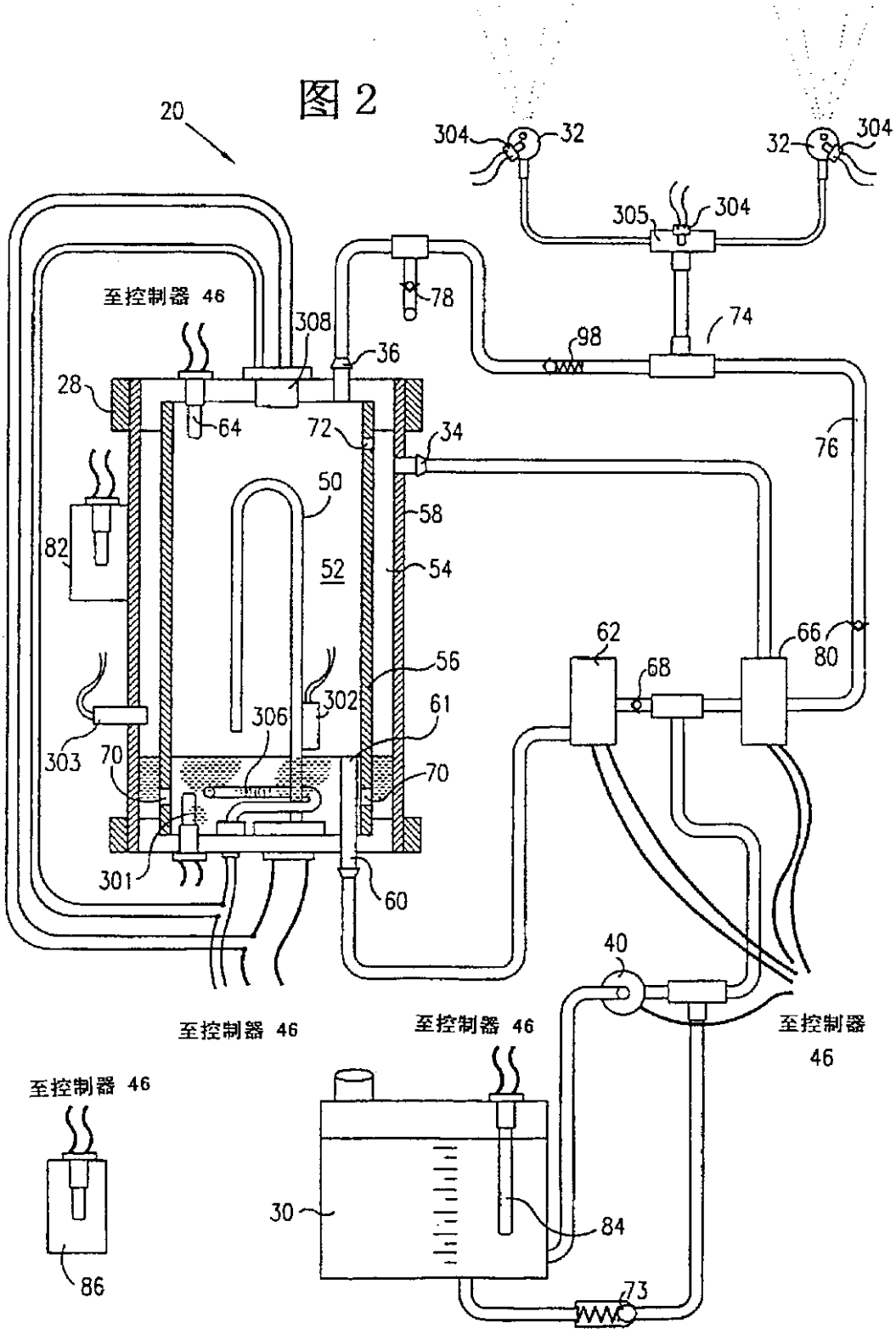

20
304
32
32
304
305
304
至控制器 46
78
74
308
98
36
28
64
72
34
76
50
58
82
52
54
62
66
80
56
68
306
302
61
303
70
70
301
60
40
至控制器 46
至控制器 46
至控制器 46
至控制器 46
30
84
73
86

图 3

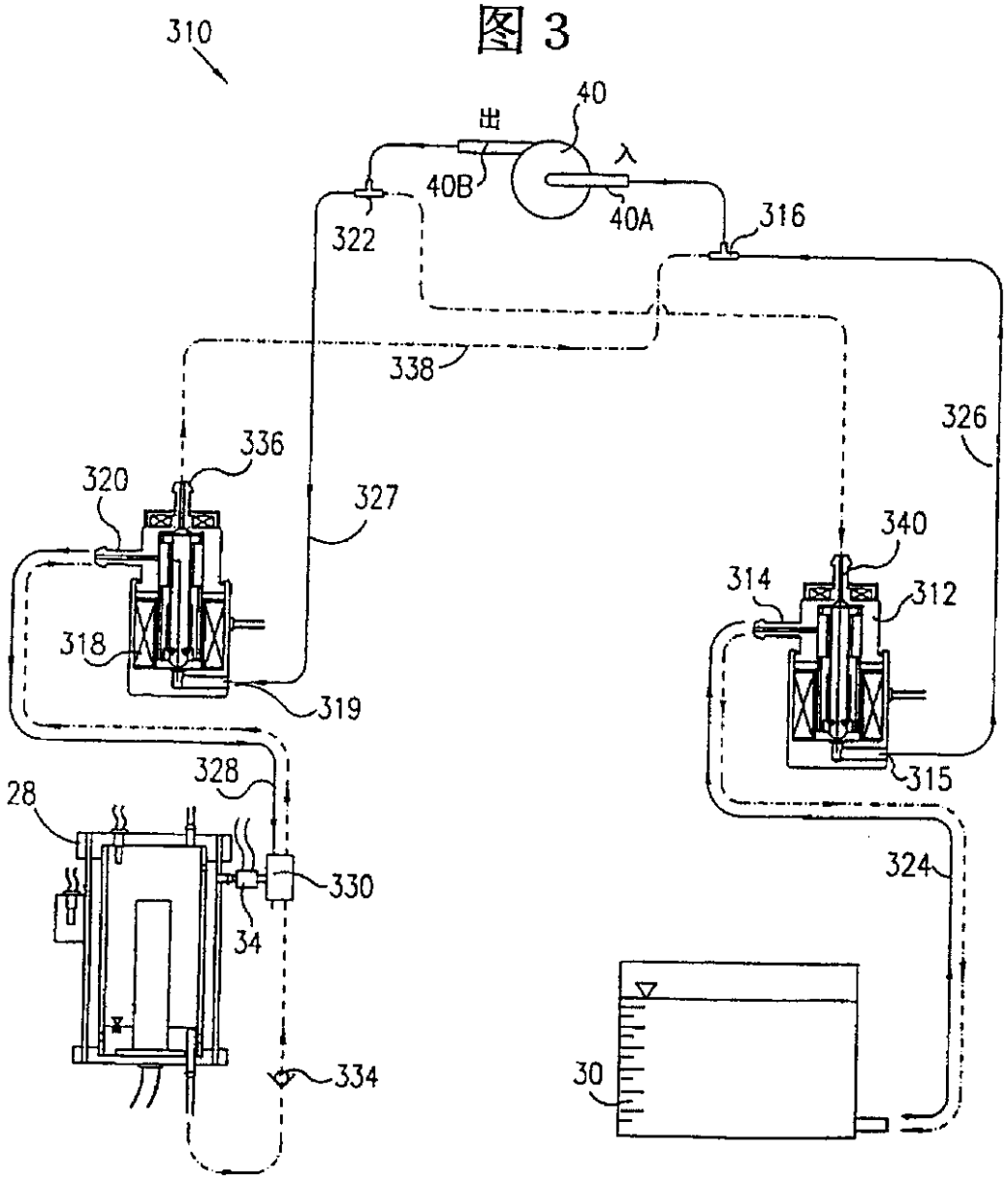

310
40
出
入
40B
40A
322
316
338
326
336
320
327
340
314
312
318
319
315
328
28
330
324
34
334
30

图 4

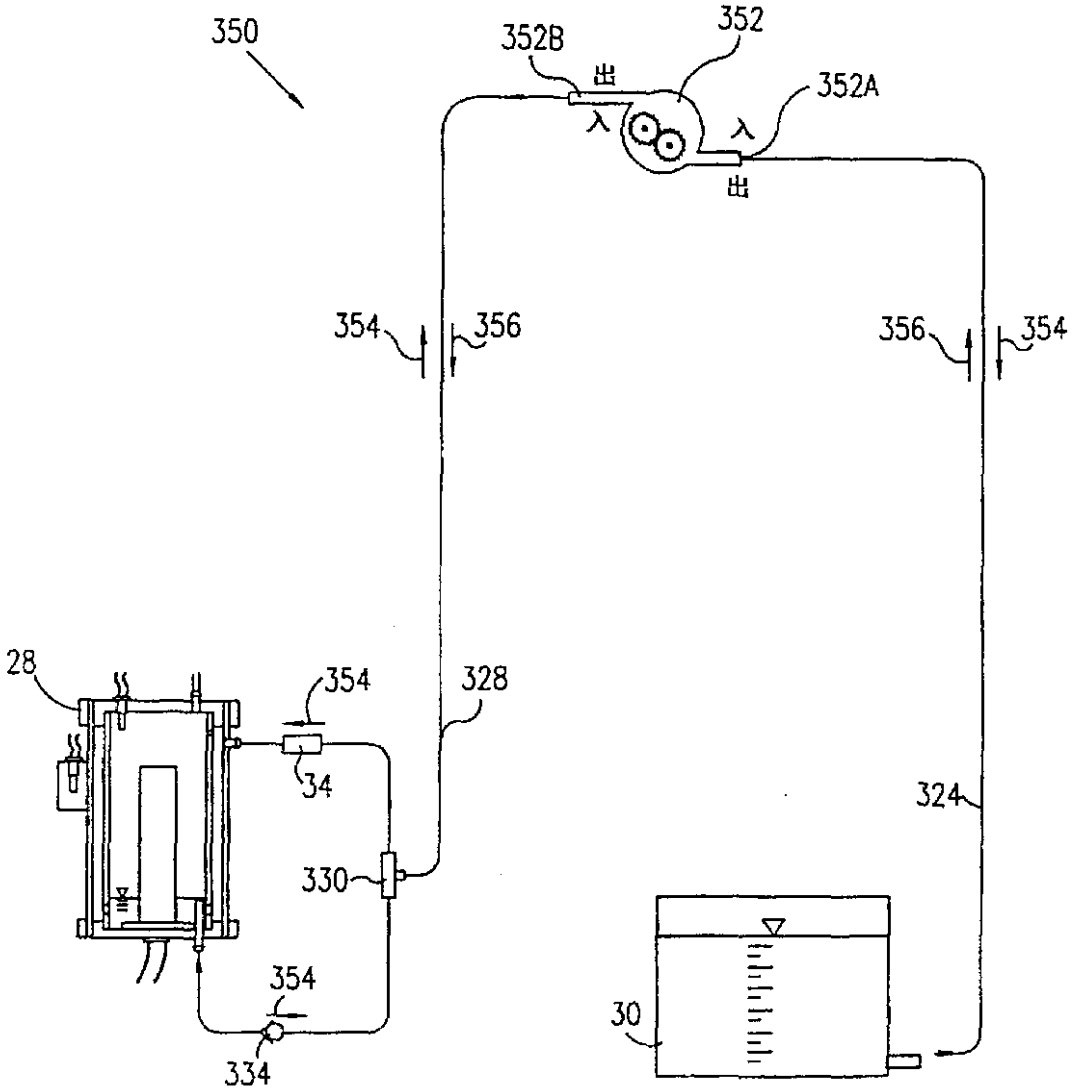
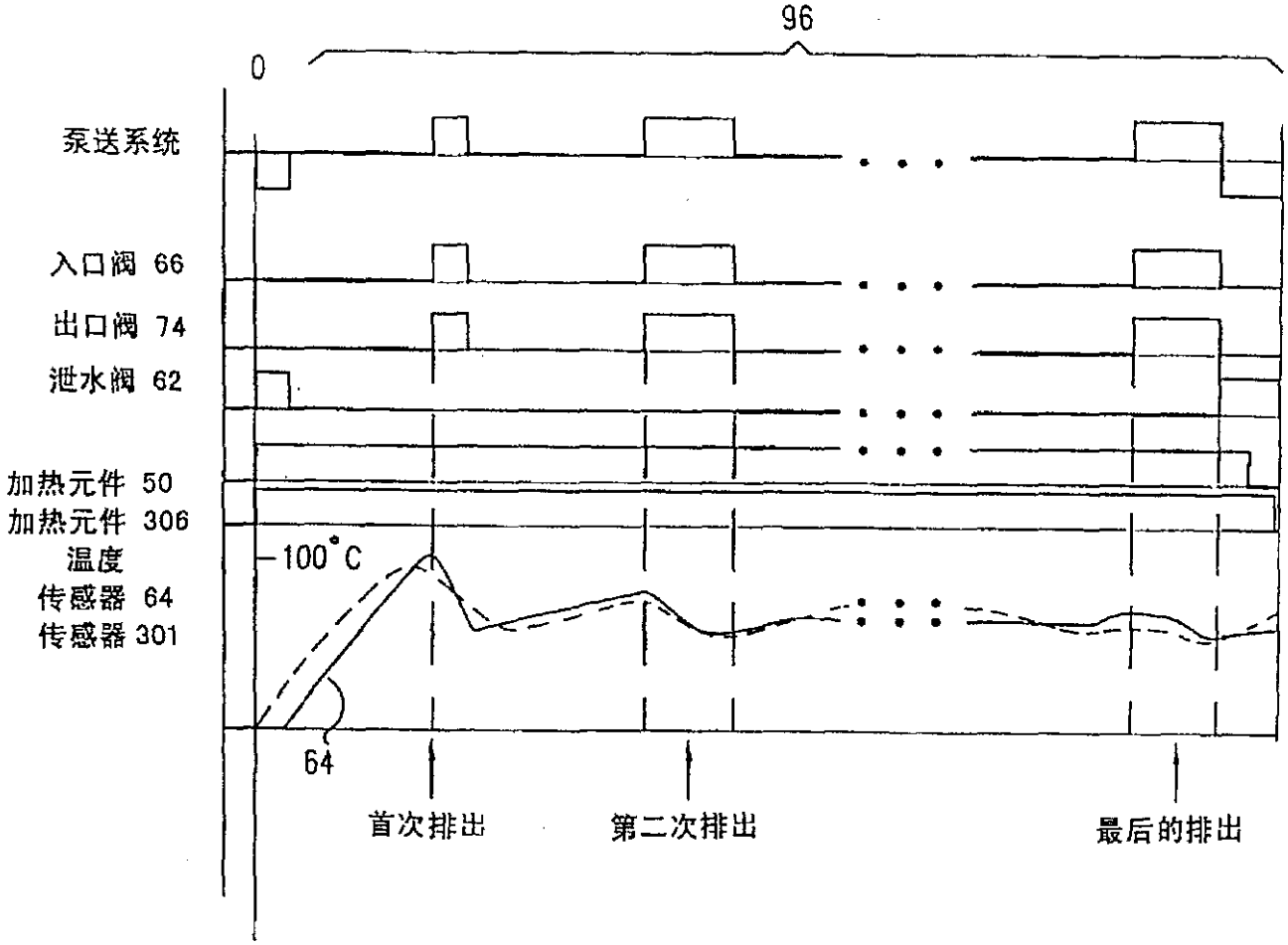

350
352B
出
入
352
352A
入
出
354
356
356
354
28
354
328
34
330
324
354
334
30

图 5


96
0
泵送系统
入口阀 66
出口阀 74
泄水阀 62
加热元件 50
加热元件 306
温度
传感器 64
传感器 301
100°C
64
首次排出
第二次排出
最后的排出

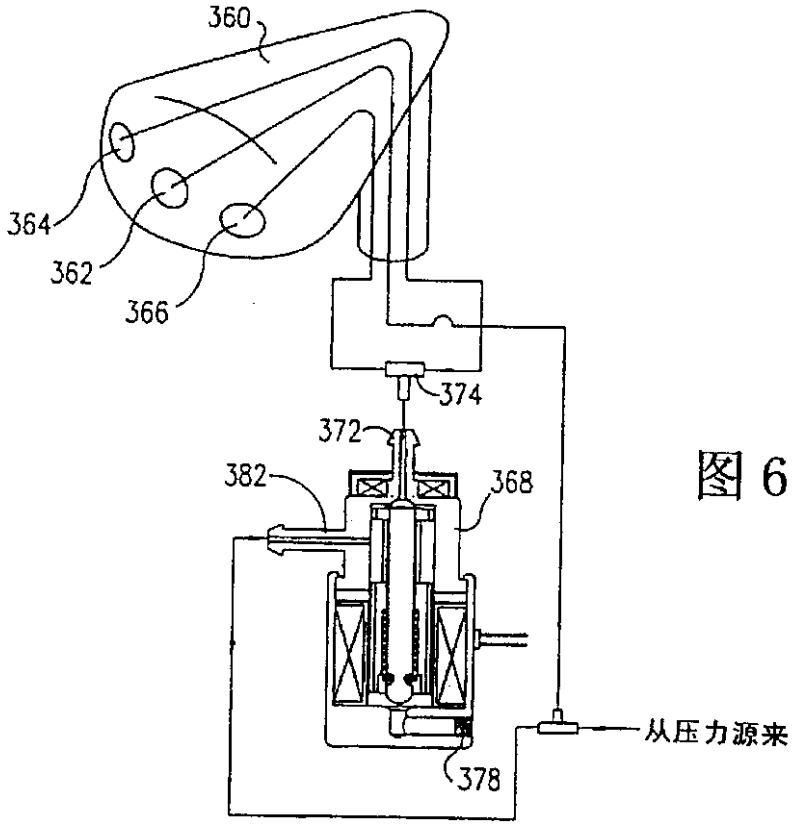

360
364
362
366
374
372
382
368
从压力源来
378

图 6

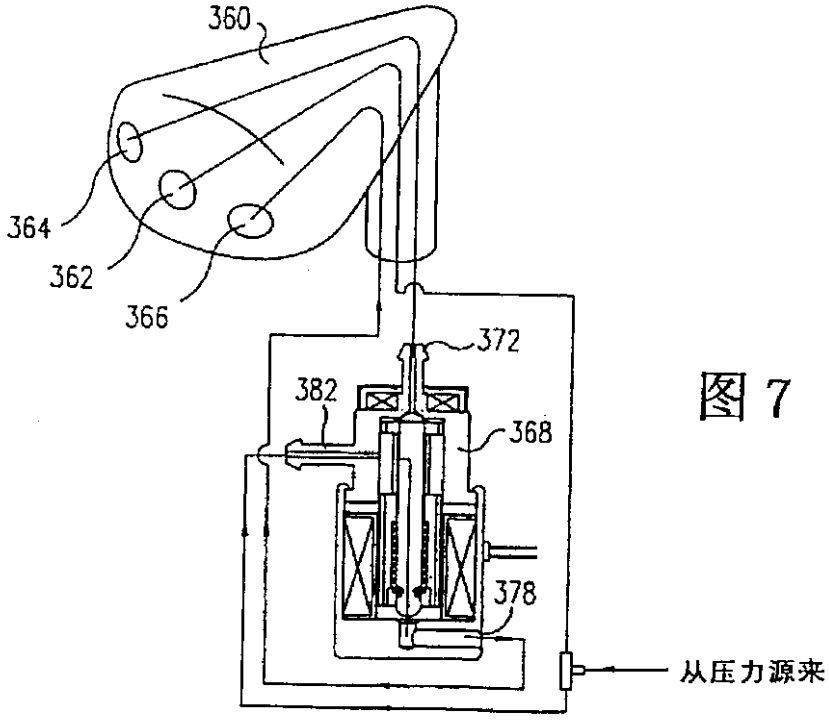
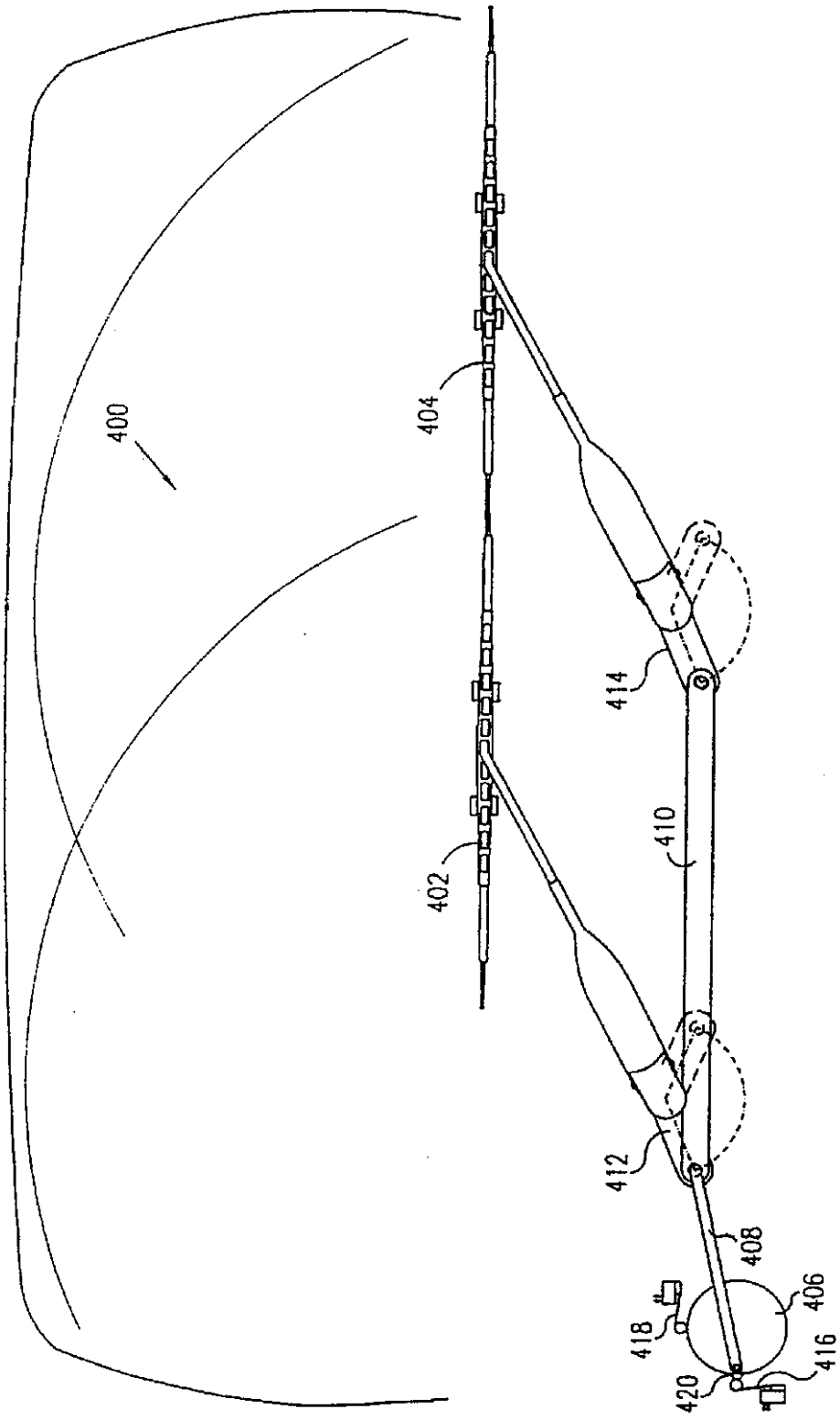

360
364
362
366
372
382
368
378
从压力源来

图 7

图 8



01.06.01

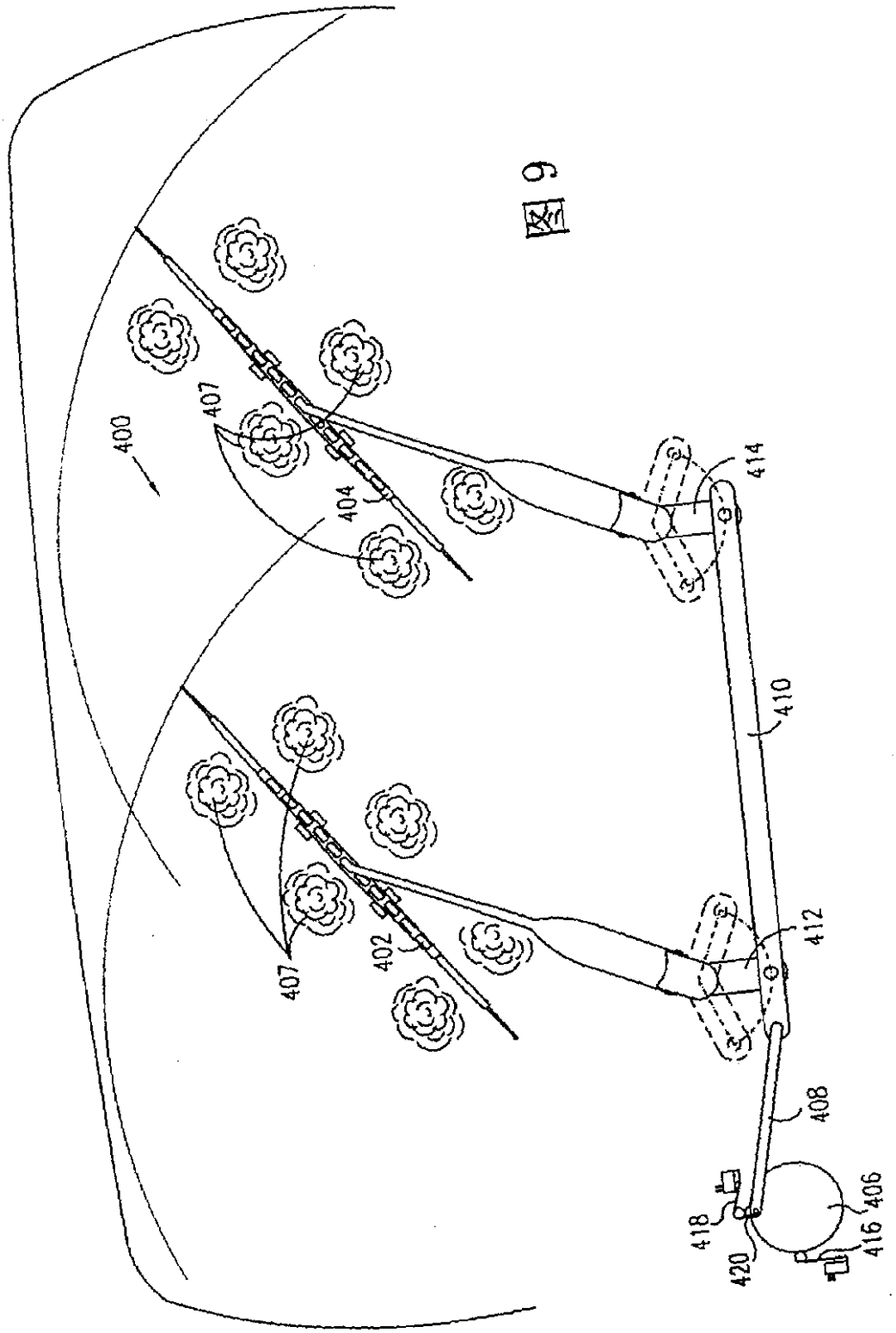


図 9

图 10

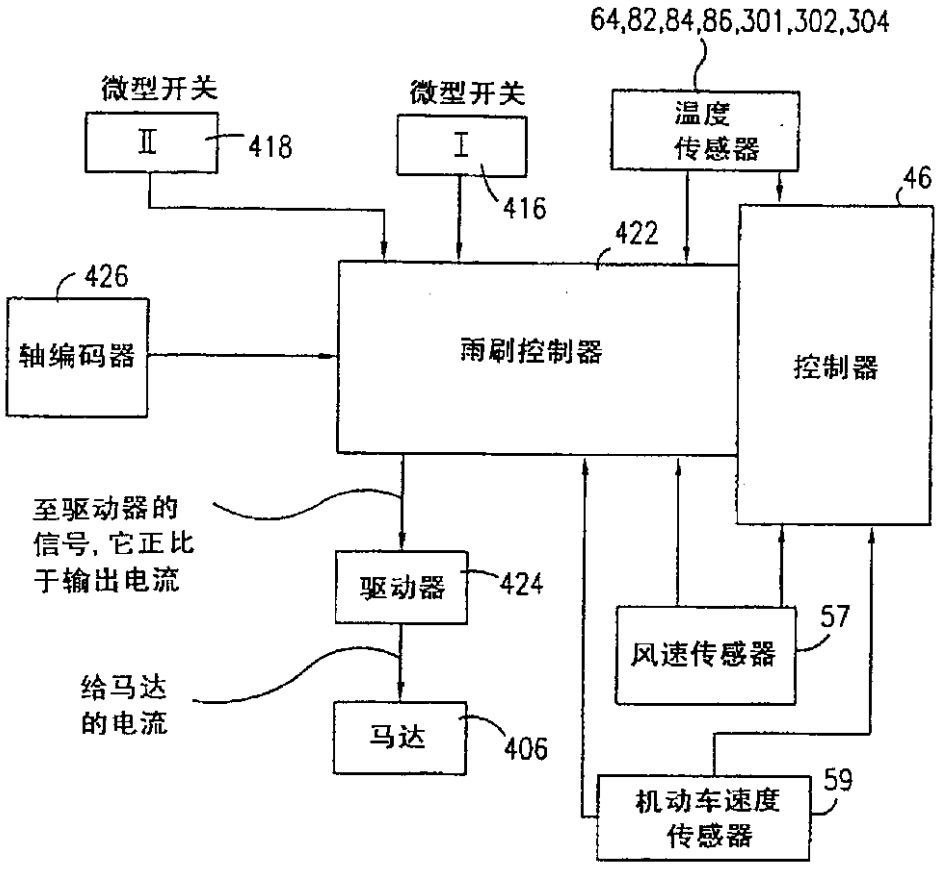

64,82,84,86,301,302,304
微型开关
Ⅱ
418
微型开关
Ⅰ
416
温度
传感器
46
422
426
轴编码器
雨刷控制器
控制器
至驱动器的
信号，它正比
于输出电流
驱动器
424
57
风速传感器
给马达
的电流
马达
406
59
机动车速度
传感器

图 11A

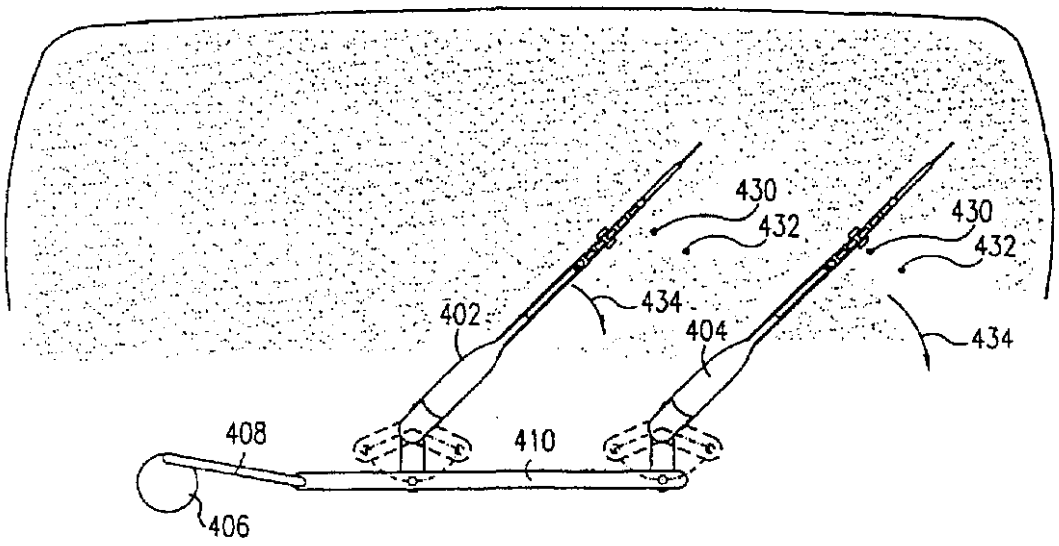

430
432
430
432
434
434
402
404
408
410
406

图 11B

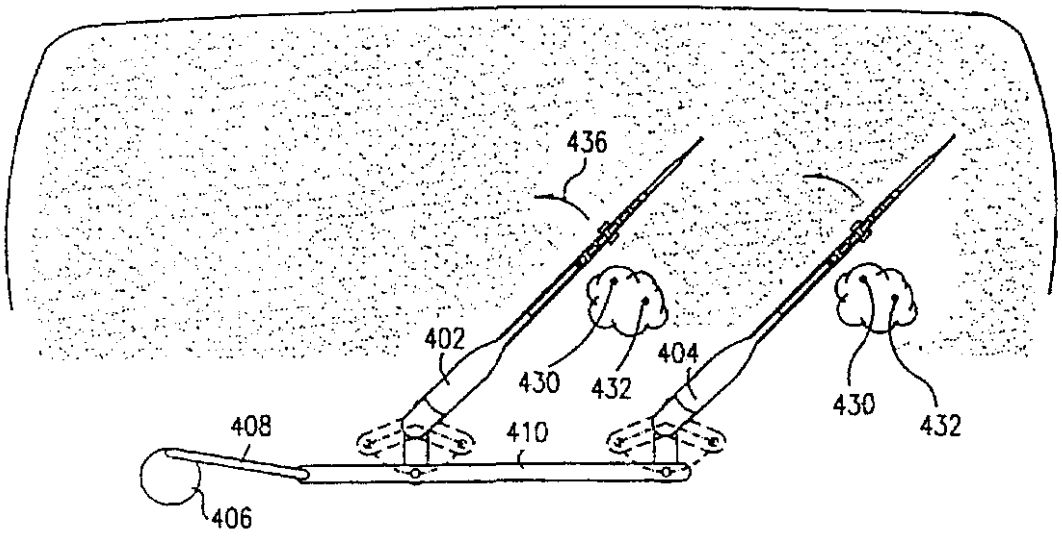

436
402
430
432
404
430
432
408
410
406

图 11C

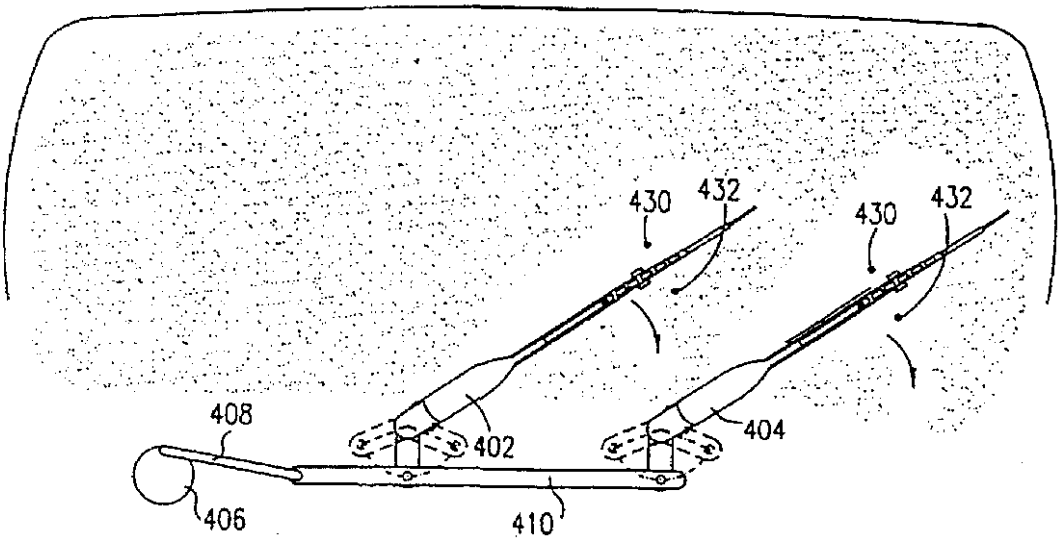

430
432
430
432
408
402
404
406
410

图 11D

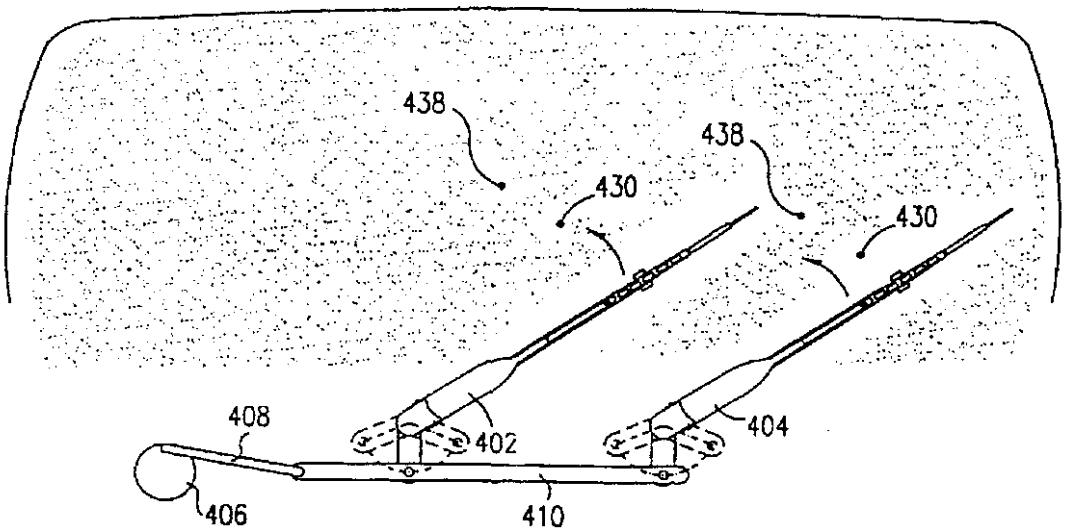

438
438
430
430
408
402
404
406
410

图 11E

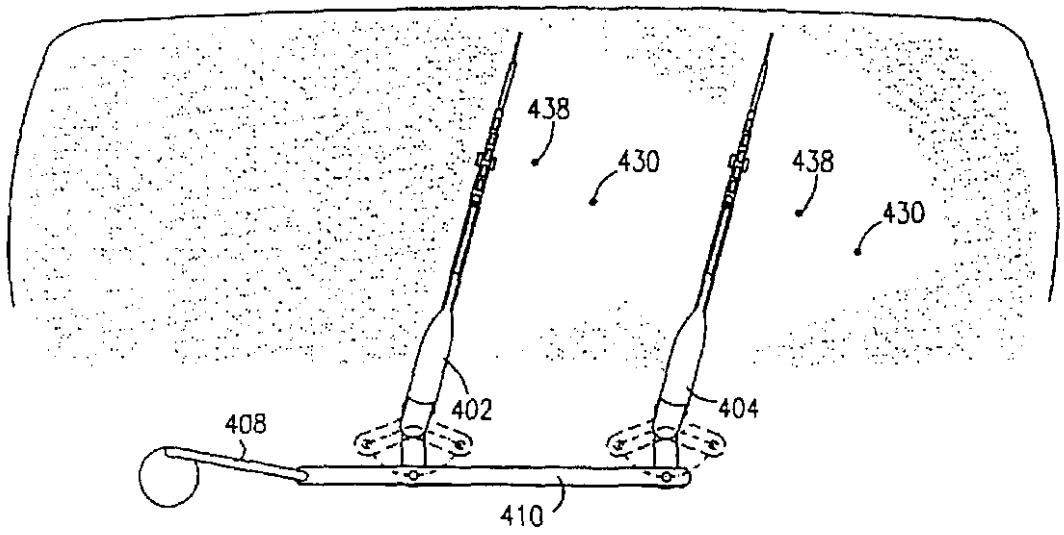
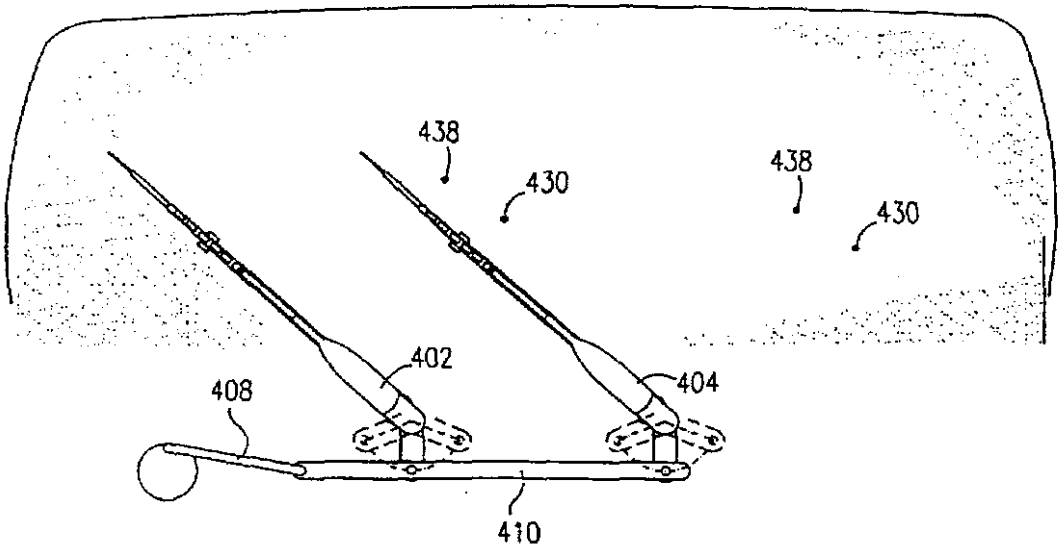


图 11F



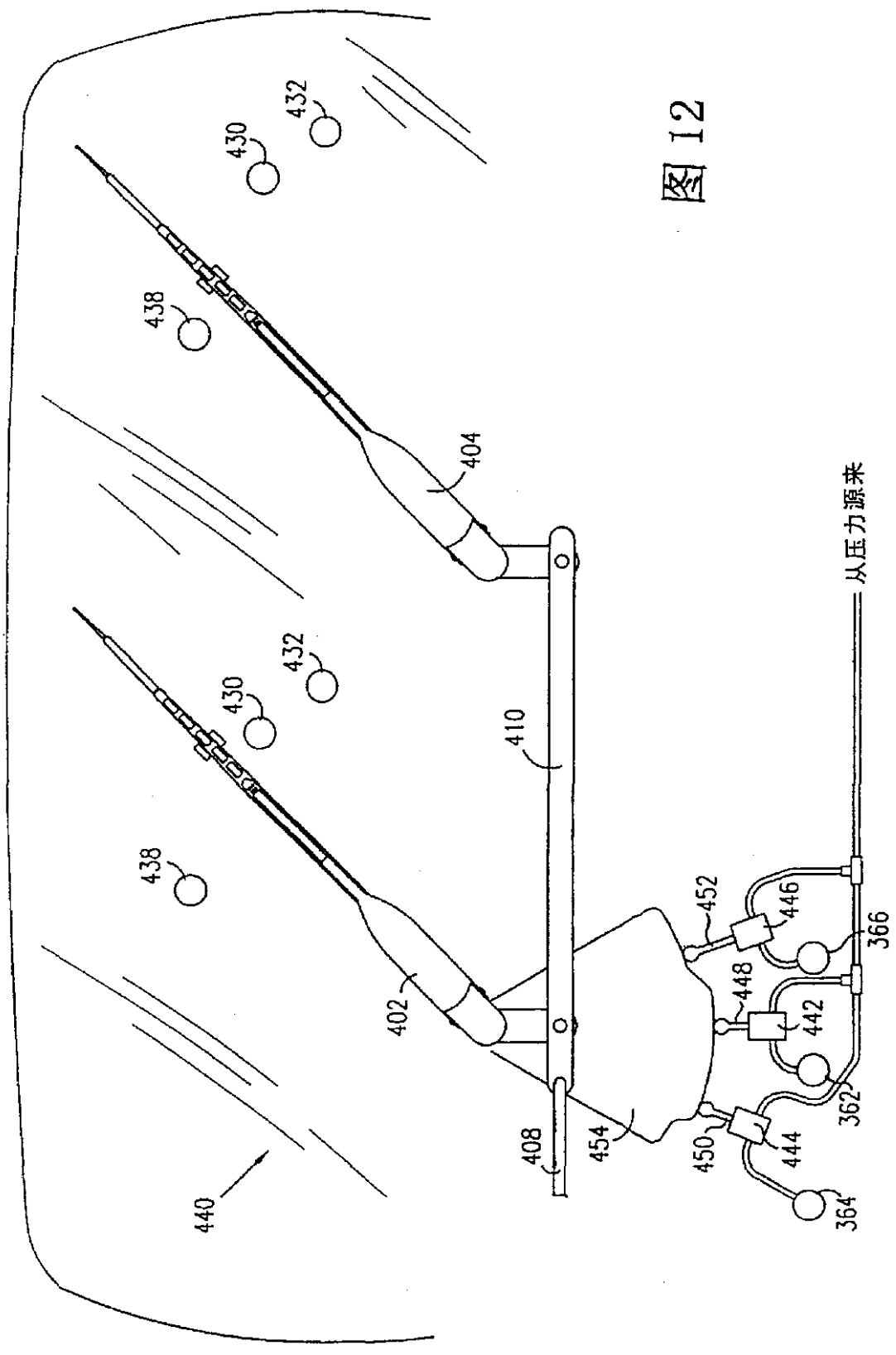

430
432
438
404
410
402
408
454
452
446
448
442
444
450
366
362
364
440
从压力源来

图 12

図 13

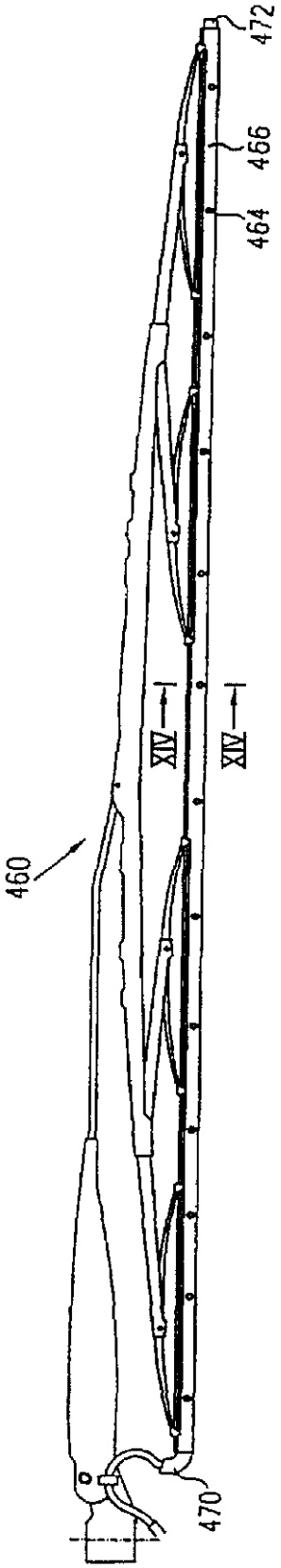


图 14

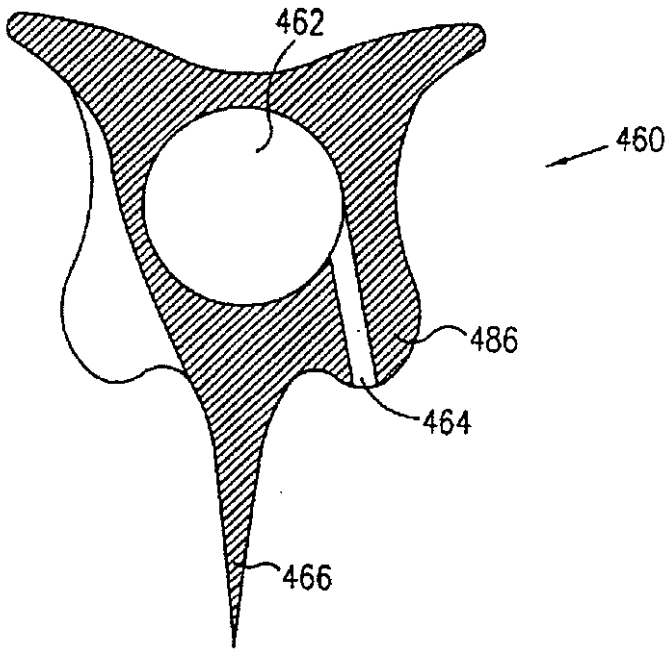


图 15

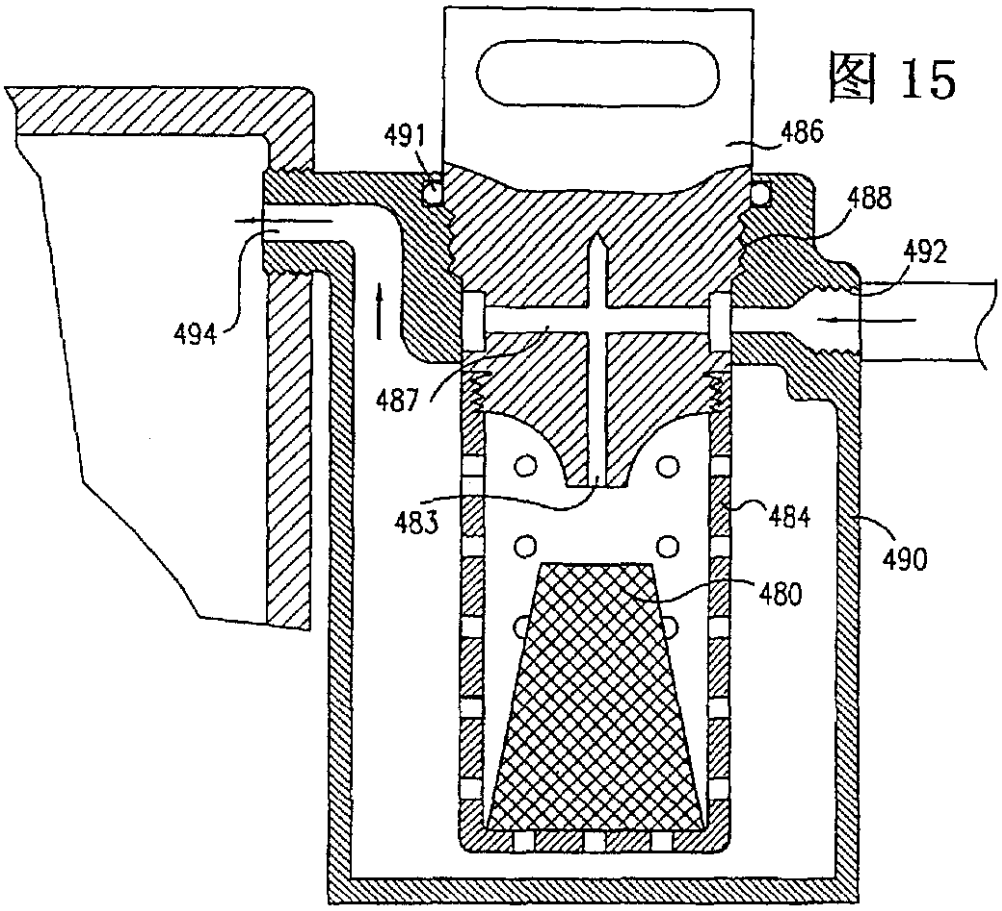

491
486
488
492
494
487
483
484
490
480

图 16

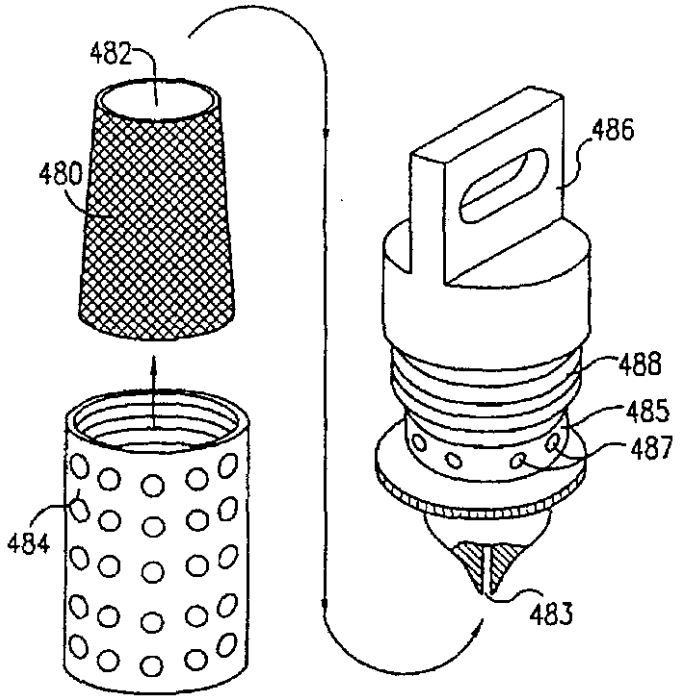

482
480
484
486
488
485
487
483

图 17

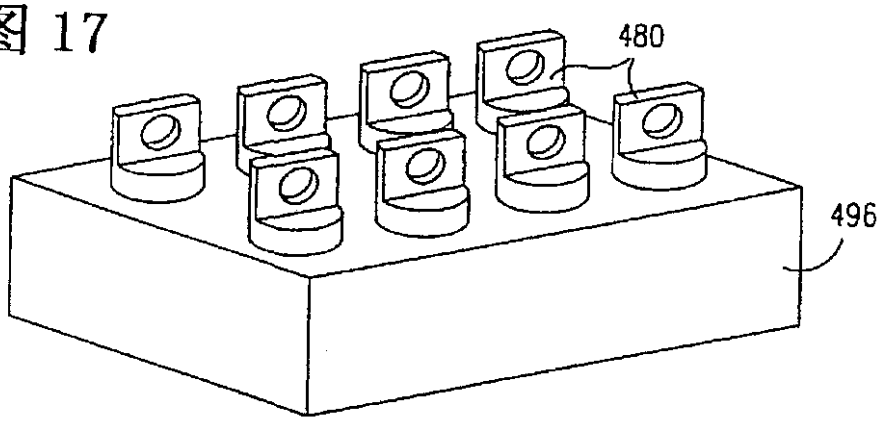


图 18

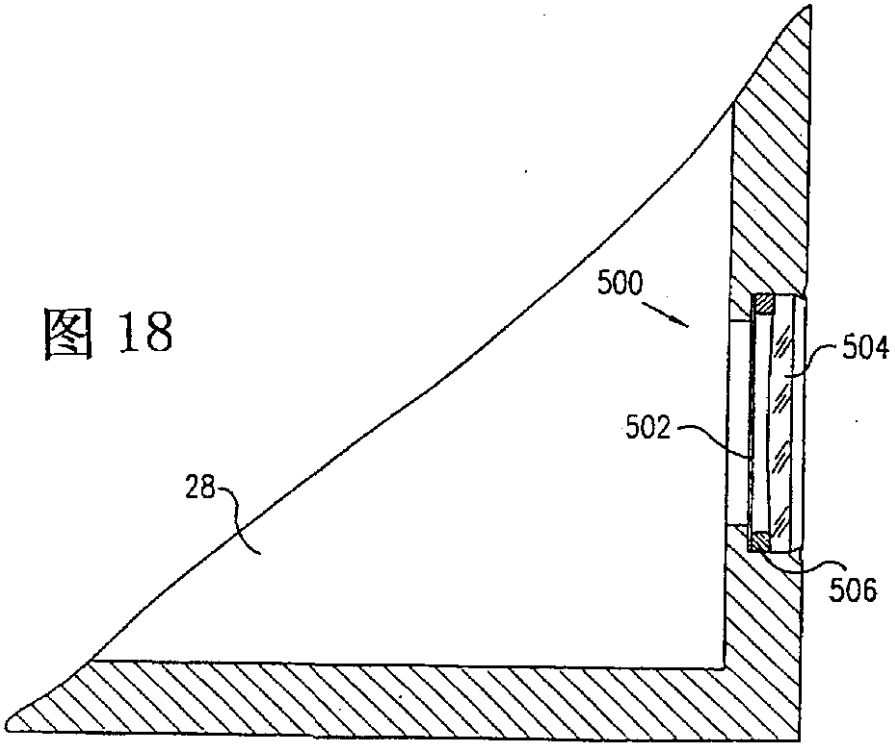
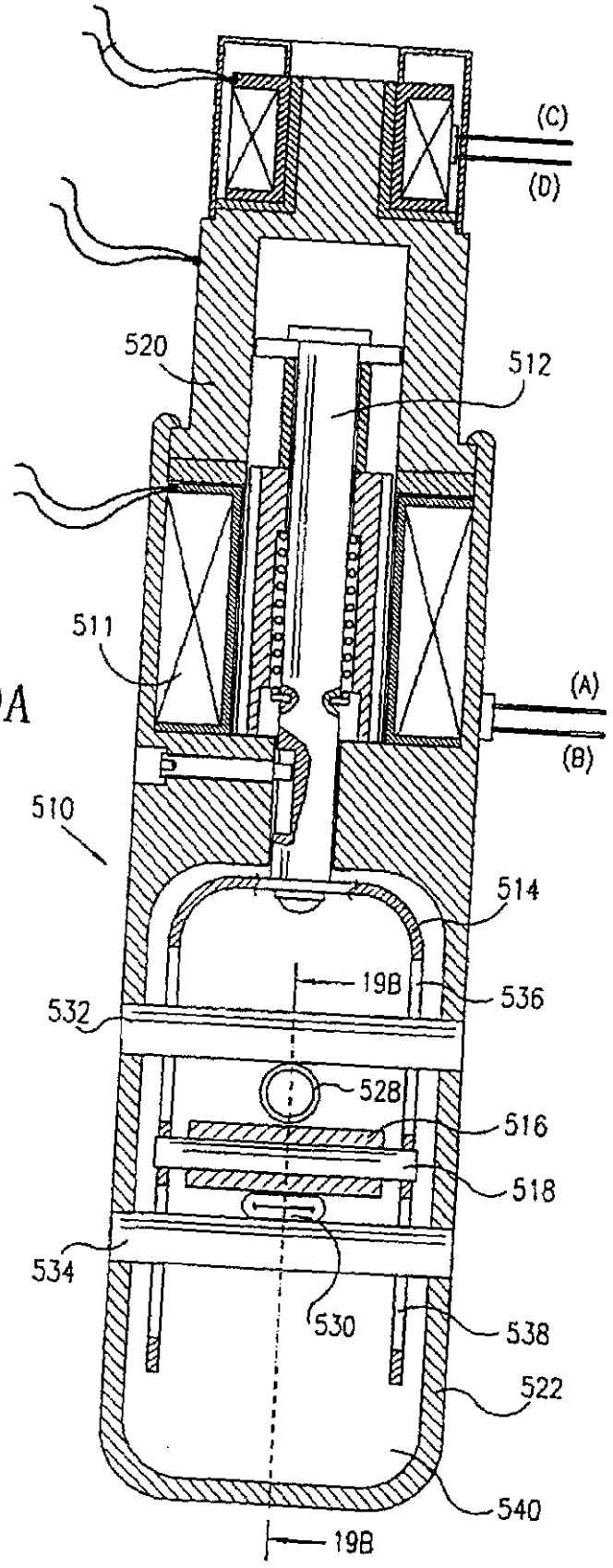


图 19A


(C)
(D)
520
512
511
(A)
(B)
510
514
19B
536
532
528
516
518
534
530
538
522
540
19B

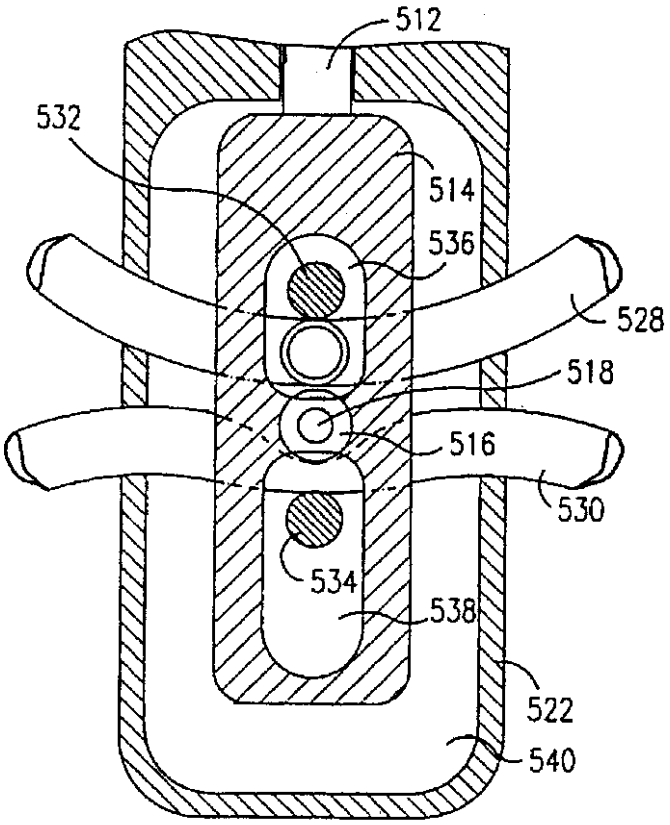
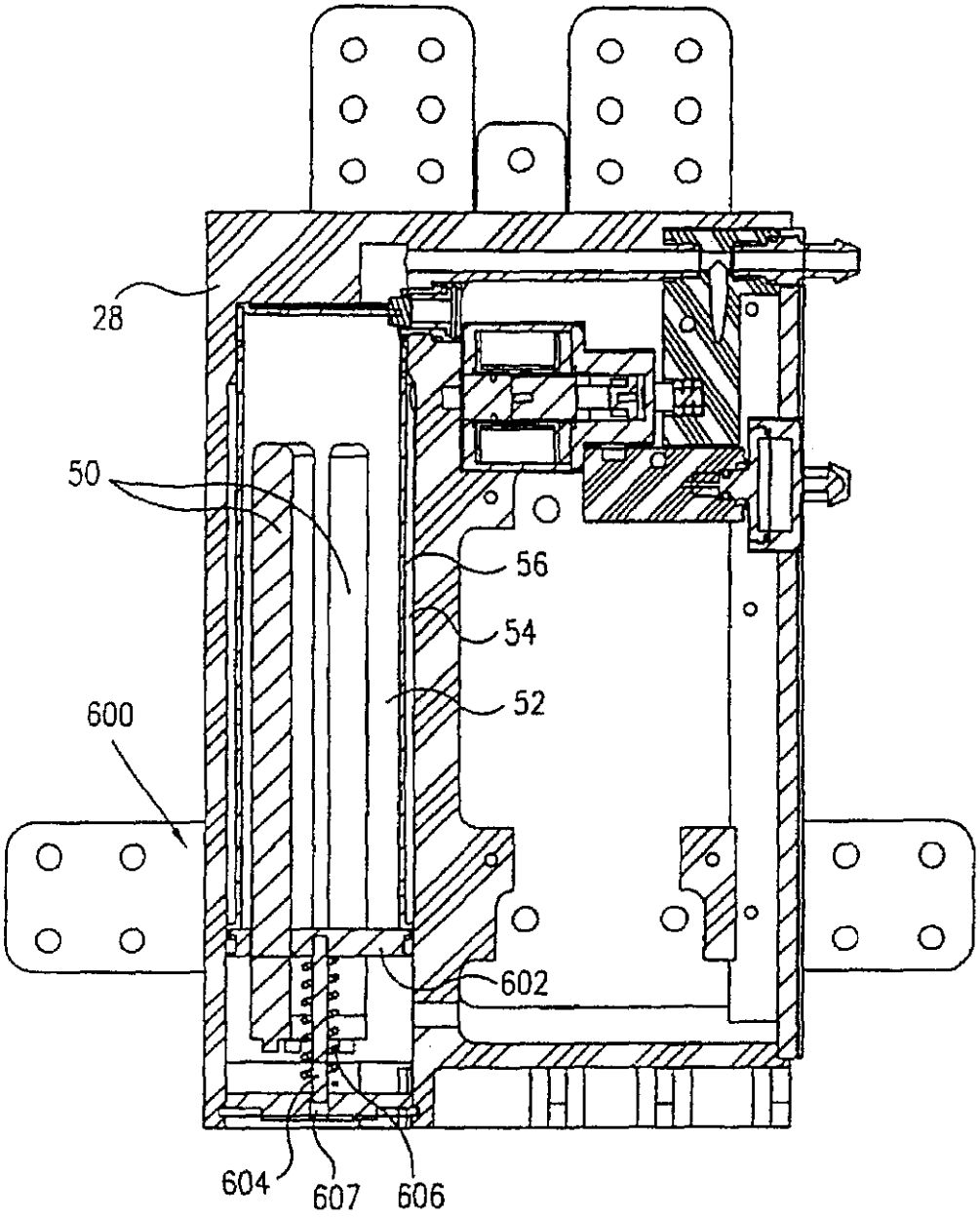


图 19B

图 20



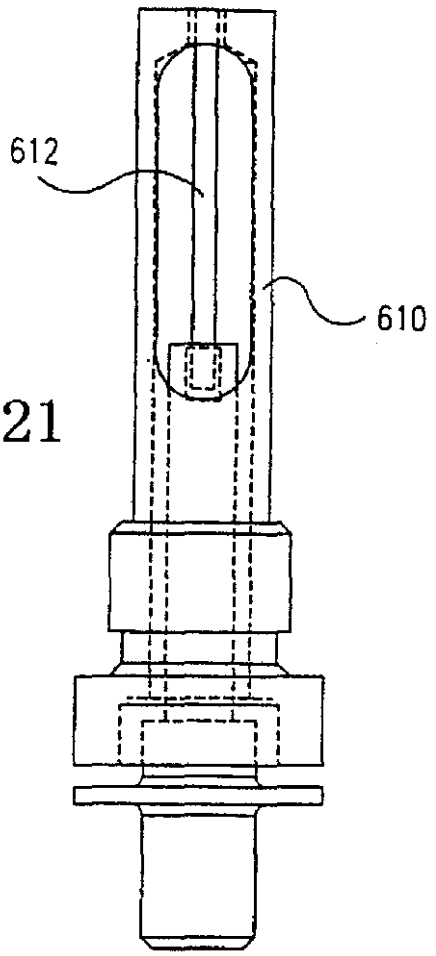


图 21

图 22

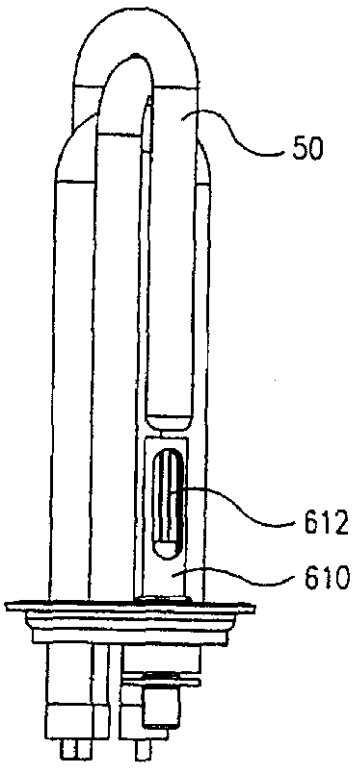


图 23

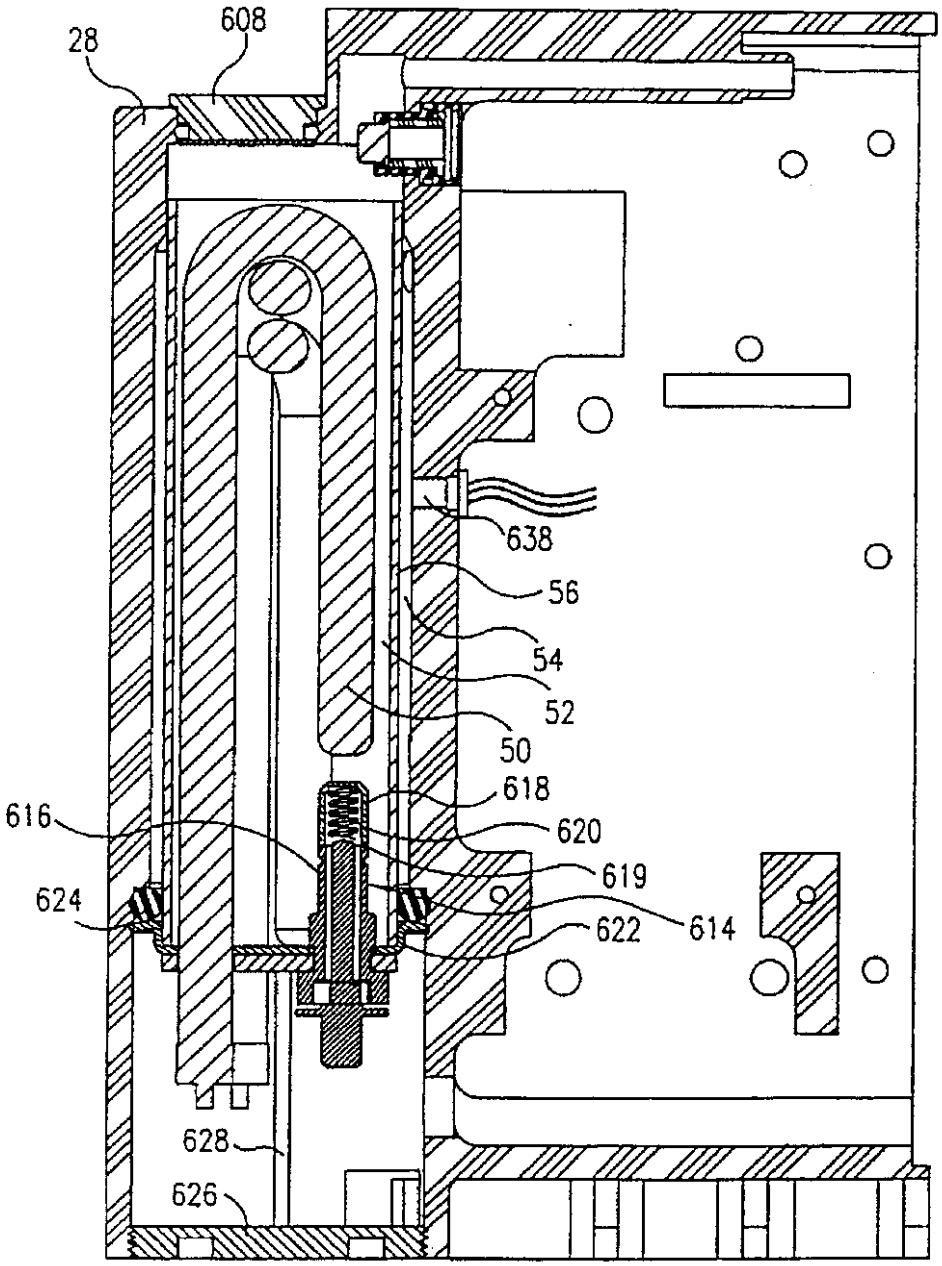


图 24

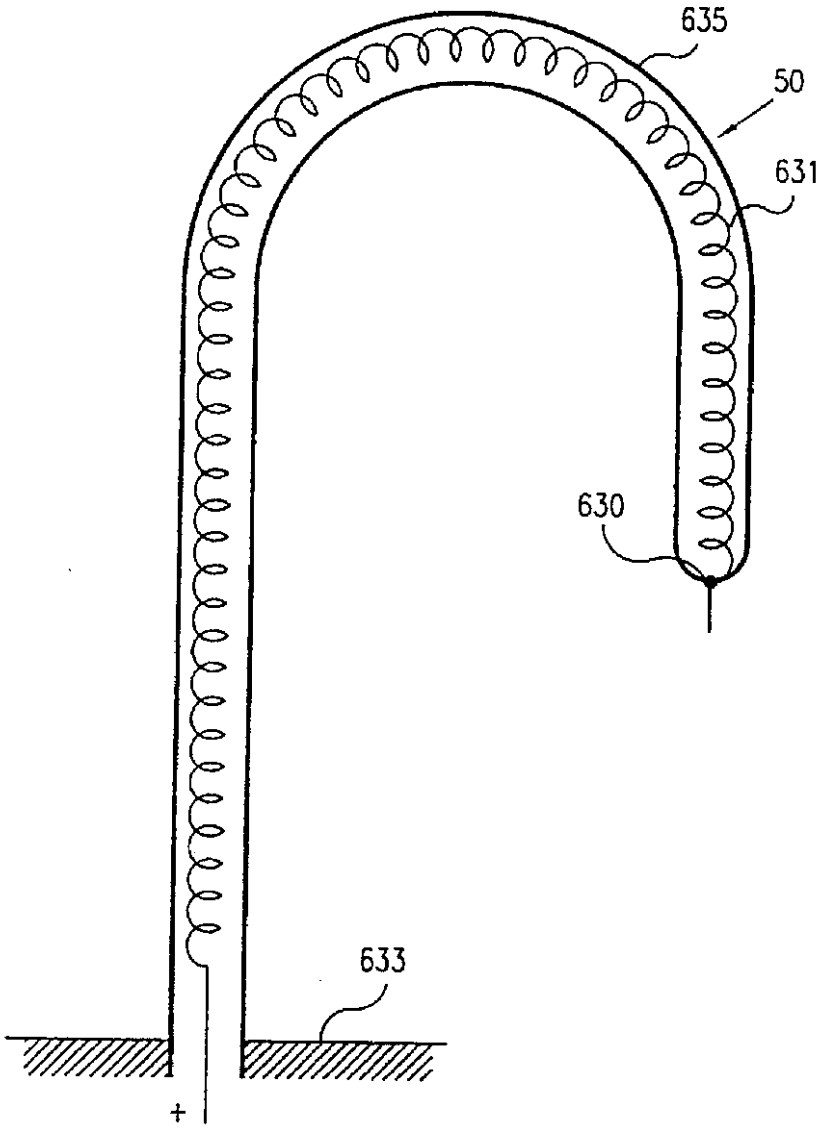


图 25

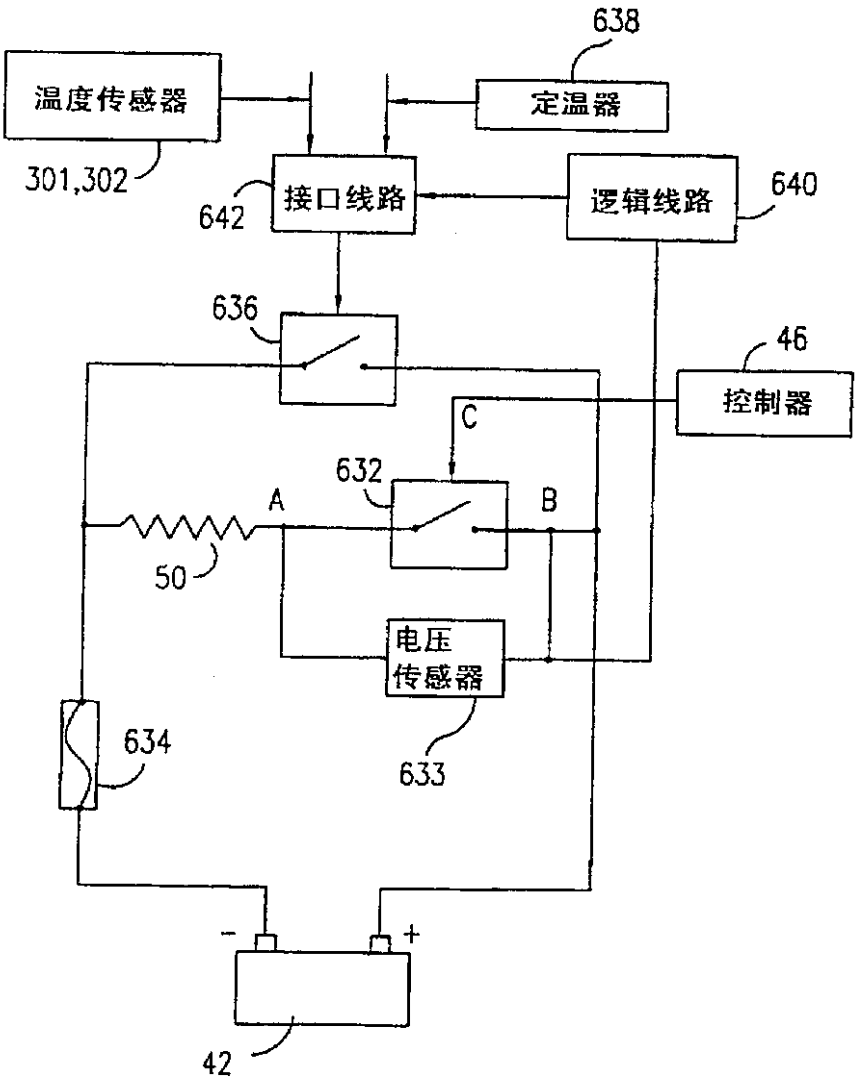

638
温度传感器
定温器
301,302
642
接口线路
逻辑线路
640
636
46
控制器
C
632
A
B
50
电压
传感器
634
633
-
+
42

图 26

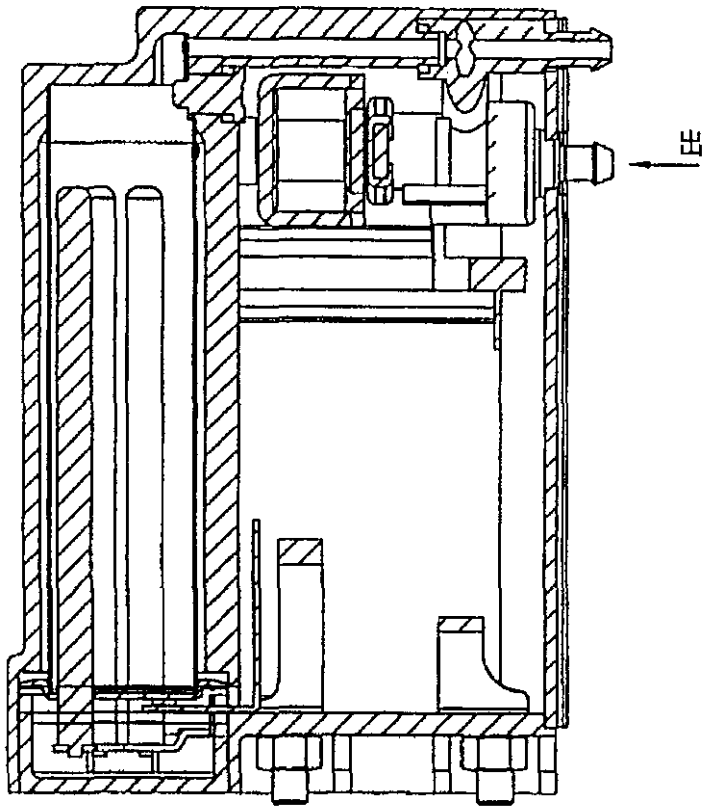


图 27

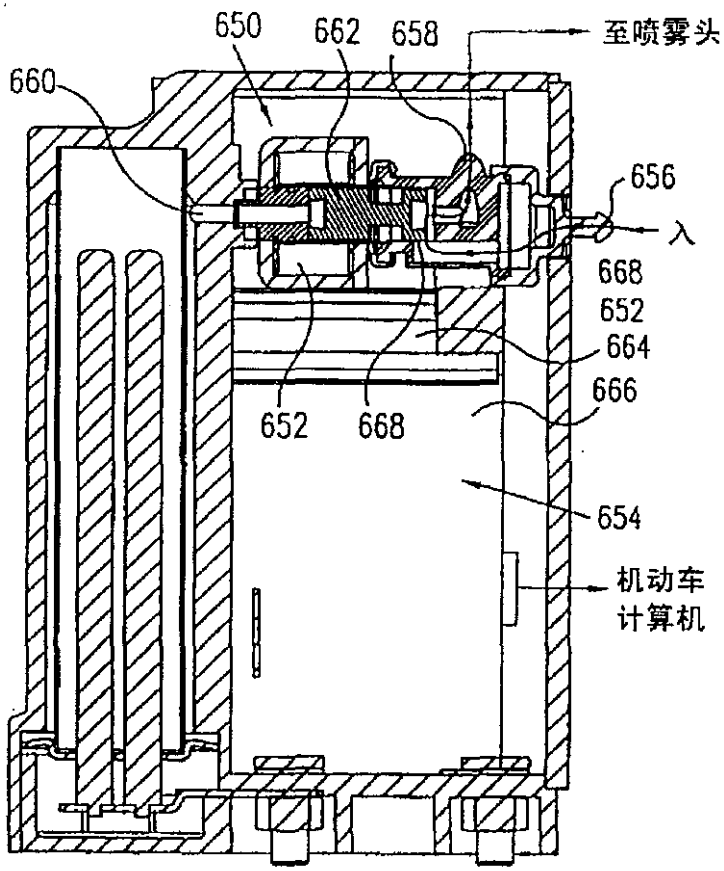


图 29

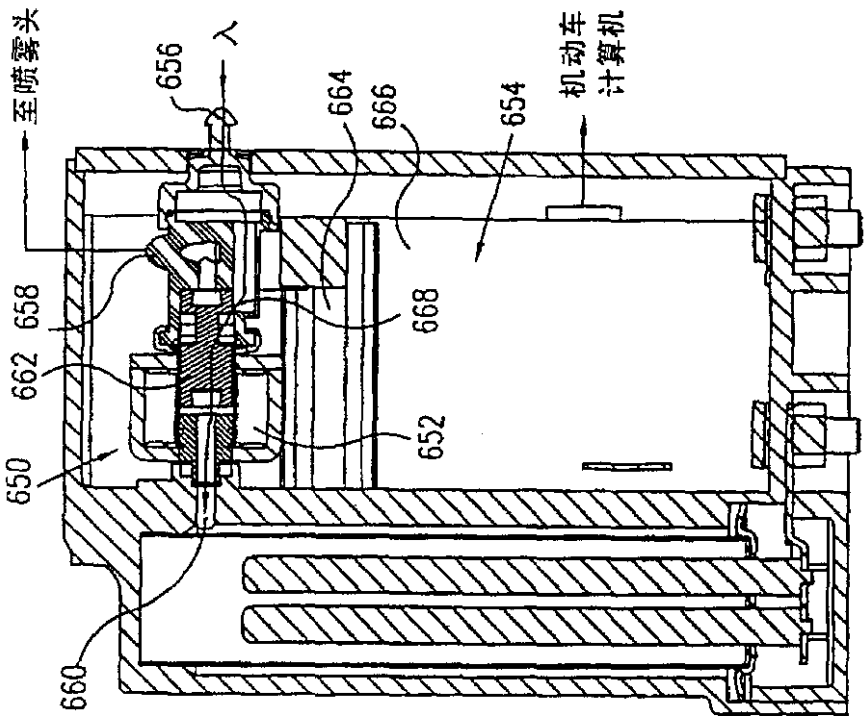


图 28