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[54] **COOLING AIR FLAP AND BLOWER CONTROL FOR MOTOR VEHICLES**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**^{4} **F01P 7/02**
[52] **U.S. Cl.** **123/41.05;** 123/41.12; 165/98
[58] **Field of Search** 123/41.04, 41.05, 41.06, 123/41.58, 41.12; 165/98

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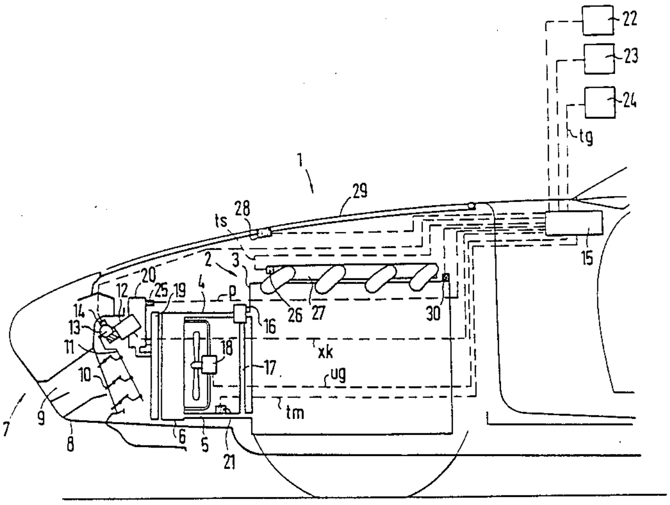
Assistant Examiner—Richard R. Cole
Attorney, Agent, or Firm—Barnes & Thornburg

[57] **ABSTRACT**

To control the cooling air requirements of an internal combustion engine and additional assemblies on a motor vehicle, a combination of cooling air flaps adjustable by an electric motor and a ventilator blower whose rpm is adjustable and which are powered by electric motors is used. One closed, one partially open, and one fully open position of the cooling air flaps as well as the rotational speed of the blower are controlled as a function of the cooling requirements of the internal combustion engine and the states of an air conditioner, a temperature of an automatic transmission fluid, a temperature of an intake manifold of the internal combustion engine, and the position of an ignition switch and an engine hood contact switch in such fashion that a cooling air stream which changes nearly continuously with the cooling requirements is created in the cooling air duct. Advantageously, in addition to the optimum protection of the system and a favorable fuel consumption, a shortened warmup phase of the internal combustion engine and improved aerodynamics of the motor vehicle are achieved by limiting the throughflow of the internal combustion engine chamber with the cooling air flaps closed or partially open.

30 Claims, 4 Drawing Sheets



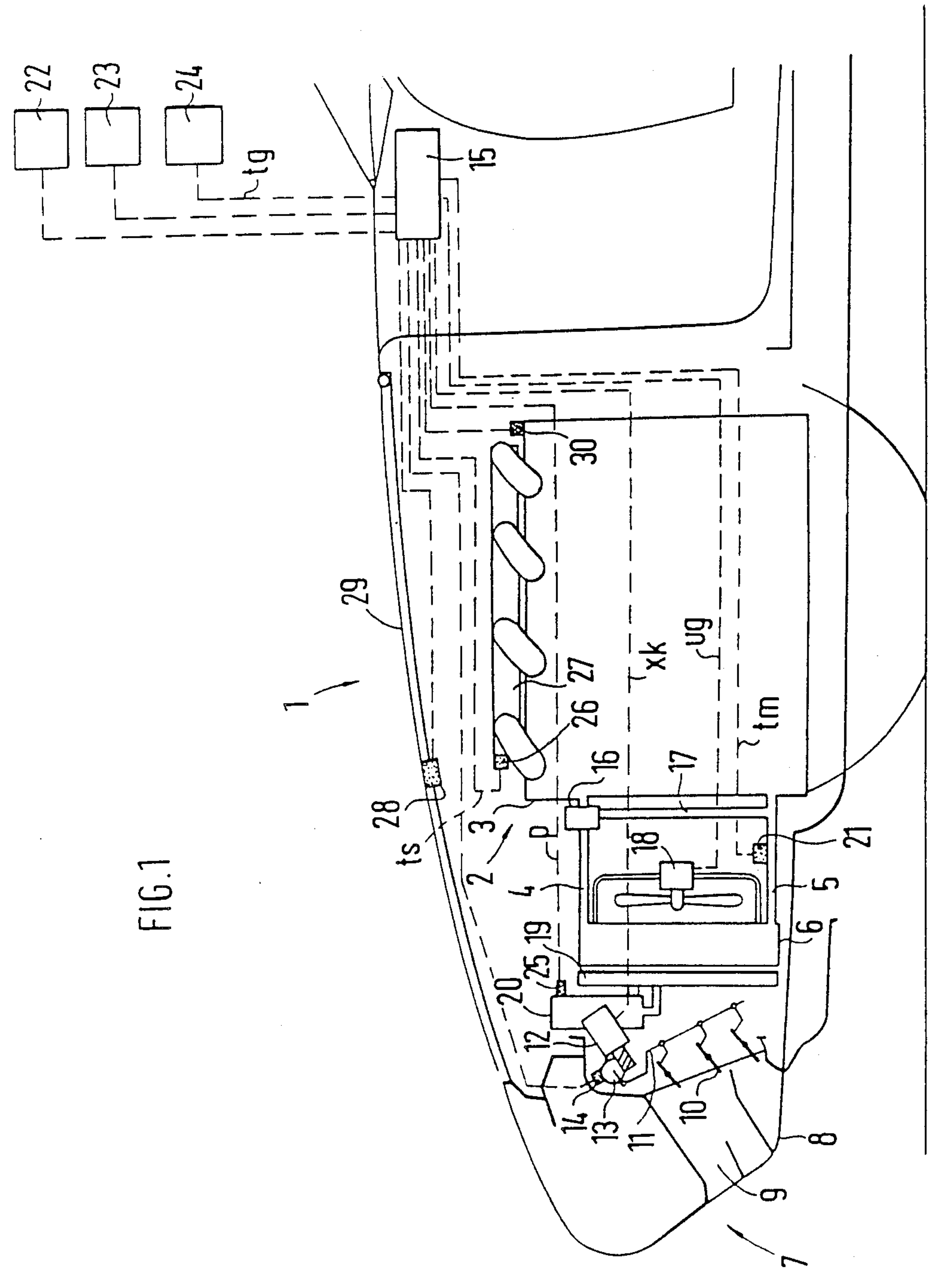

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FIG.1

FIG. 2

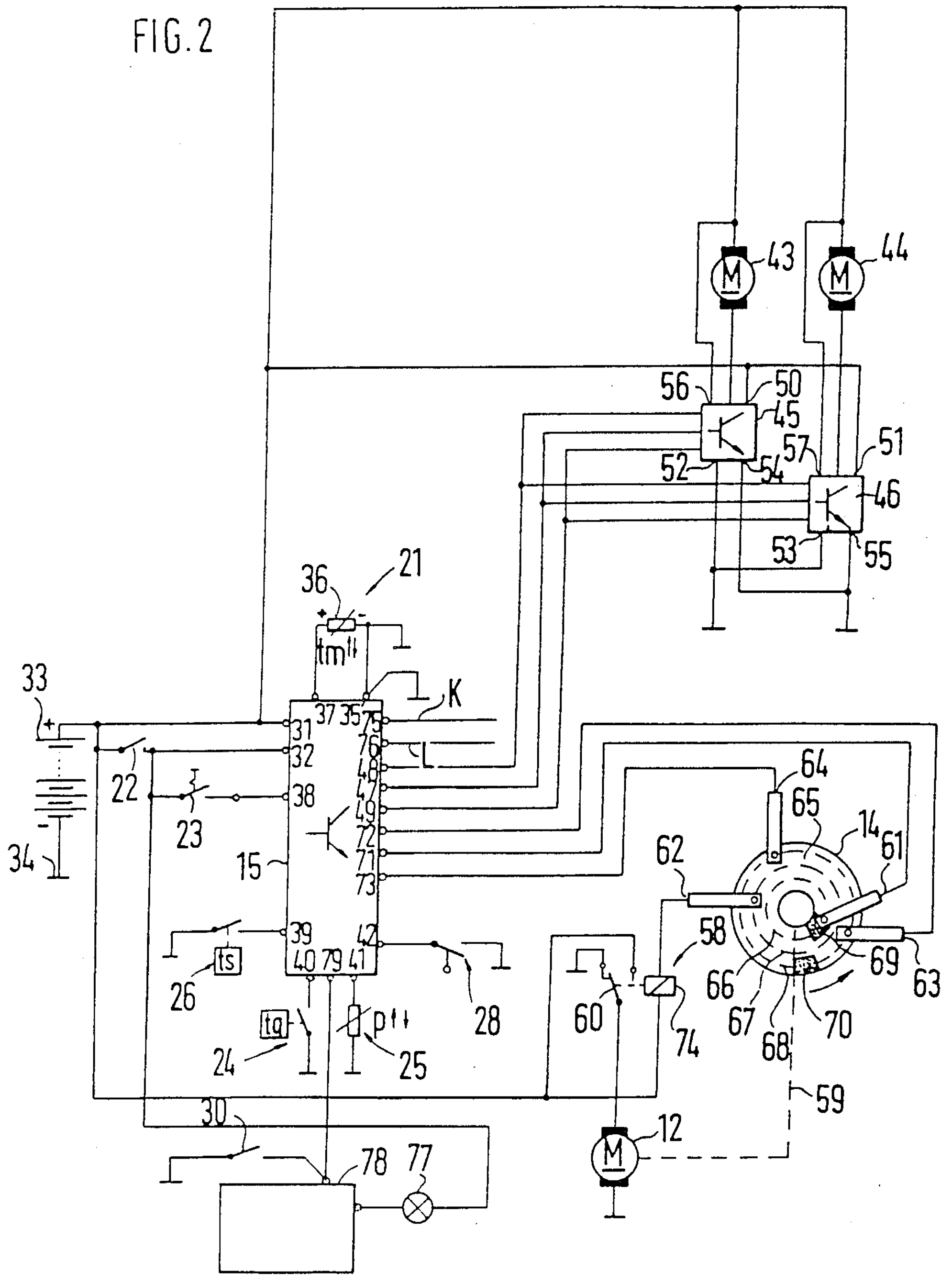
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FIG. 3

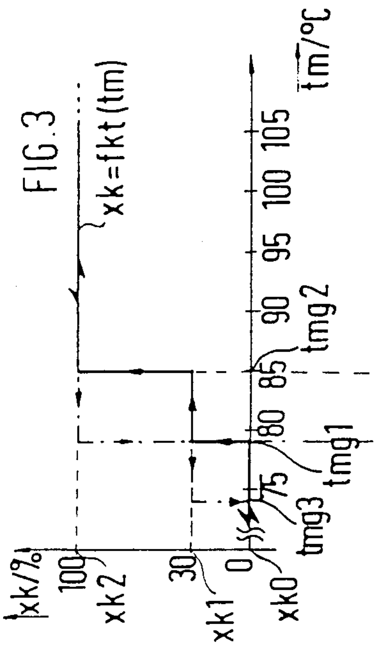


FIG. 5

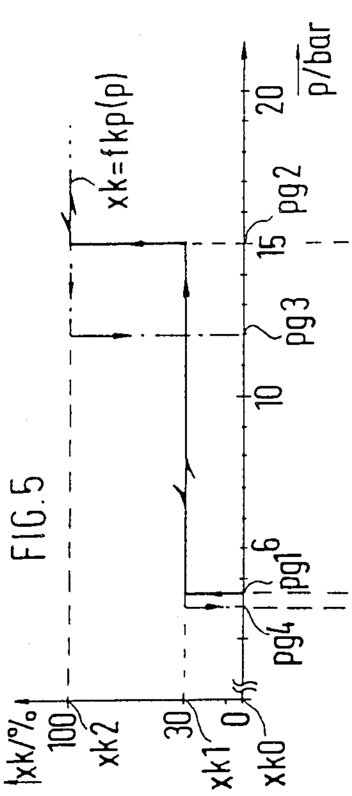


FIG. 4

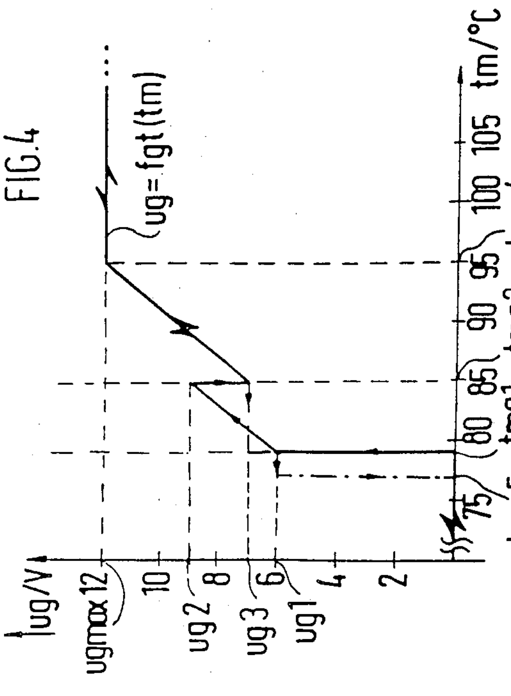


FIG. 6

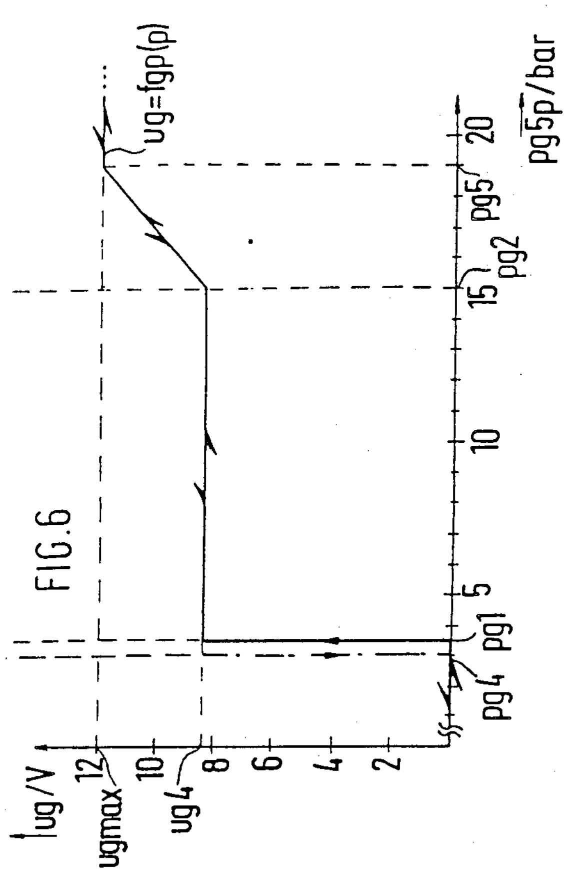


FIG.7

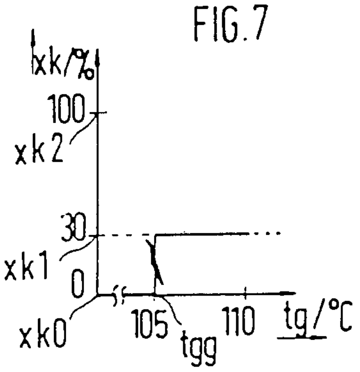


FIG.9

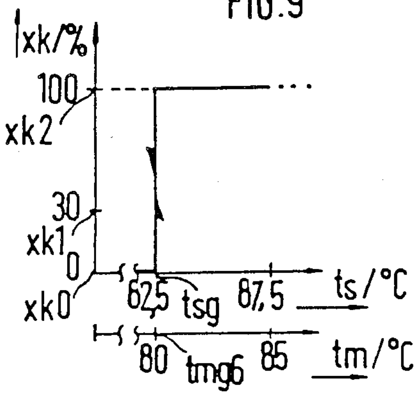


FIG.8

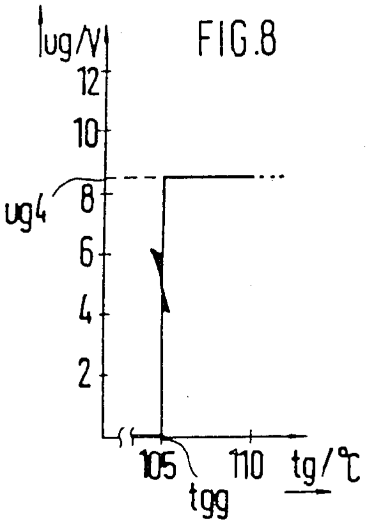


FIG.10

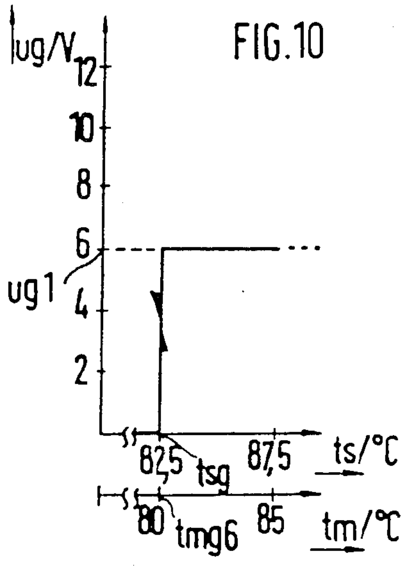
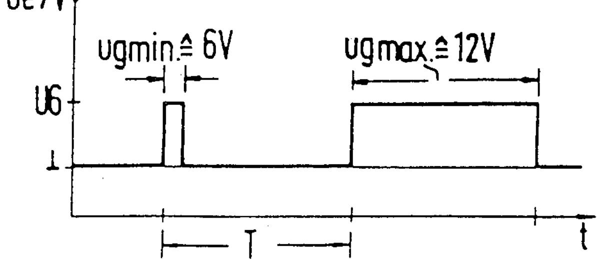


FIG.11



COOLING AIR FLAP AND BLOWER CONTROL FOR MOTOR VEHICLES

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to a cooling air flap and blower control for motor vehicles, especially high performance passenger automobiles of the type having an engine radiator cooling air stream generated by movement of the vehicle, with controllable flaps for controlling the flow of air in response to certain vehicle operating conditions.

Recent developments in motor vehicles, especially automobiles, in very recent times have increasingly reflected the standpoint of optimal aerodynamic design, especially to increase driving performance and reduce fuel consumption. One important factor in this regard is the throughflow required through the engine compartment to cool the engine, which has a negative effect on the so-called coefficient of air resistance. It is also desirable for the engine, following a starting procedure from the cold state, to warm up rapidly to an operating temperature at which it can operate with optimum economy and service life, and to keep the latter as constant as possible during operation.

German OS No. 32 11 793 teaches a coolant temperature regulatinig system for a motor vehicle engine which, in addition to the conventional coolant temperature regulation using a thermostat in a bypasss circuit for the coolant for the engine and the cooling air blower which is switched on and off by a thermostat, additionally controls a shutter in an opening in the car body through which cooling air flows.

It is true that this deals with the requirement to improve aerodynamics. However, the controlling elements used all exhibit more or less of a two-point characteristic so that the operating temperature of the engine cannot be kept constant at a required level. The resulting constant fluctuations around a set operating point produce a poor quality of regulation and hence load and wear on the engine, including all the assemblies and parts traversed by the cooling water. In addition, the adjusting element of the shutter, which is designed as an element made of expanding material and is affected only by the coolant, cannot be set sufficiently accurately and permits no additional parameters to adjust the cooling air stream to the cooling air needs of the engine and auxiliary or additional assemblies.

To improve the quality of regulation, combined regulating systems with continually operating adjusting elements have been proposed "Motortechnische Zeitschrift", Volume 20, No. 5, May 1959, pages 141 to 142. These hydraulically or hydrostatically operating systems however, are extremely cumbersome and expensive; their use is admissible only when the internal combustion engine already has a pressurized oil supply. Another problem is the compressed oil leaks which are always present in hydraulic or hydrostatic systems.

U.S. Pat. No. 4,133,185, to Robert B. Dickey, relates to an automatic air circulation control, including air inflow shutters. U.S. Pat. No. 4,546,742, to Fred D. Sturges, also discloses controllable radiator shutters in a temperature control system for internal combustion engines.

An object of the invention is to provide an improved coolant and blower control for motor vehicles which optimally regulates the temperature environment of an internal combustion engine including its auxiliary and additional assemblies of acceptable cost and also fully takes into account the aerodynamic aspects of the motor vehicle.

The advantages of the invention lie primarily in the fact that a cooling air flap and blower control for motor vehicles is provided which controls the cooling air requirements of an internal combustion engine of a motor vehicle including all auxiliary and additional assemblies with outstanding quality control. In addition, it is readily adjustable to varying conditions in different types of motor vehicles in internal combustion engines, requires only a small amount of room for installation, and is inexpensive to manufacture and install.

Further objects, features, and advantages of the present invention will become more apparent from the following description when taken with the accompanying drawings(s) which show, for purposes of illustration only, an embodiment/several embodiments in accordance with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross sectional view through the engine compartment of a motor vehicle schematically depicting a cooling air flap and blower control arrangement constructed in accordance with a preferred embodiment of the invention;

FIG. **2** is a schematic diagram of the circuit for controlling the cooling air flap and blower control arrangement of FIG. **1**;

FIG. **3** is a graph showing a control function for positioning cooling air flaps as a function of temperature in the coolant circuit of an internal combustion engine according to a preferred arrangement of the presention invention;

FIG. **4** is a graph similar to FIG. **3**, but for a blower;

FIG. **5** is a graph similar to FIG. **3**, but for a control function for positioning cooling air flaps as a function of pressure in a coolant circuit of an air-conditioner;

FIG. **6** is a graph similar to FIG. **5**, but for a blower;

FIG. **7** is a graph similar to FIG. **3**, but for the positioning of the cooling air flaps as a function of the temperature of a lubricant of a transmission;

FIG. **8** is a graph similar to FIG. **3**, but for the blower;

FIG. **9** is a graph similar to FIG. **3**, but for positioning the cooling air flaps as a function of the temperature of an intake manifold or coolant circuit when the internal combustion engine is shut off;

FIG. **10** is a graph similar to FIG. **9**, but for the blower; and

FIG. **11** is a graph showing voltage as a function of time for a scanning ratio of the arrangement of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

In FIG. **1**, a motor vehicle is schematically depicted wherein in the forward portion or engine compartment **2** an internal combustion engine **3** is located in the forward portion or engine compartment **2**. The engine **3** is connected by coolant lines (supply **4**, return **5**) with a heat exchanger (liquid radiator **6**), which can be exposed to the head wind through an opening in the body **7** in the nose **8** of a vehicle and a cooling air duct **9**.

Cooling air duct **9** is openable and closable by means of cooling air flaps **10** whose positions are controllable.

Cooling air flaps **10** are controlled via control rod **11** (crank drive) by an electric motor **12** with flanged drive **13**. A control disk **14** is nonrotatably mounted on a transmission output shaft (not shown), by means of which disk, cooling air flaps **10** can be controlled to assume a closed position (xk=0%), a partially open position (xk=30%), and a completely open position (xk=100%). Control disk **14** and electric motor **12** are connected to a control device **15** for this purpose by means of a relay which will be discussed in greater detail below.

It should be pointed out that the connections represented by dashed lines in FIG. **1** between the individual assemblies merely represent symbolic operating connections which provide no detailed information about the nature and number of the electrical leads installed (signal leads, power supply leads). The latter are apparent to an individual skilled in the air by virtue of the structural characteristics of the devices employed and described herein.

In addition, a conventional thermostatic valve **16** is shown in coolant circuit **4, 5, 6** of internal combustion engine **3**, said valve short-circuiting the coolant path via a bypass line **17** during the warmup phase of internal combustion engine **3**.

A blower **18** driven by an electric motor is disposed between heat exchanger **6** and internal combustion engine **3**, by means of which blower, heat exchanger **6**, internal combustion engine **3**, and a condenser **19** of an air conditioner **20** shown schematically (said condenser being located upstream of the heat exchanger looking in the direction of travel) can be subjected to a flow of forced air (additional heat exchangers can also be provided in the cooling air stream, for example a boost air radiator or a radiator for a fluid circuit of an automatic transmission, next to, above, or behind one another).

The rotational speed of blower **18** is continuously adjustable by means of control device **15** and an electronic end stage, shown later. One parameter for controlling the blower rpm and cooling air flap position is a temperature tm (coolant temperature) of internal combustion engine **3** which is detected by means of a coolant temperature sensor **21** in return **5** of coolant circuit **4** to **6**.

In addition to the coolant temperature tm, other parameters are involved in the control system. Control device **15** receives signals from an ignition switch **22** (ignition on or off), an air conditioner switch **23** (air conditioner on/off), a temperature sensor **24** (temperature switch) in the liquid circuit of the automatic transmission, a pressure sensor **25** in a coolant circuit of air conditioner **20**, a temperature sensor **26** (temperature switch) in or on intake manifold **27** of internal combustion engine **3** and a hood contact switch **28** which monitors the closed position of motor hood **29** to lock engine compartment **2**. Finally, an excess temperature switch **30** can be connected to control device **15** to monitor the temperature of the engine at its cylinder block or head and preferably turn on a warning light on the dashboard of the motor vehicle directly and/or indirectly via a central processing unit (to display danger situations; not shown here).

The electrical connections between the individual elements can be seen in the circuit in FIG. **2**. Control device **15** is connected directly via an input **31** and indirectly via an input **32** via ignition switch **22** with the positive terminal (+) of a battery **33**, whose negative terminal (−) is connected to the vehicle ground **34**; control device **15** is connected to the latter by means of an input **35**.

The coolant temperature sensor **21** is an NTC resistor **36** connected to inputs **35** and **37**. Signals from air conditioner switch **23**, temperature sensor **26** on the intake manifold (temperature limit switch) and temperature sensor **24** in the fluid circuit of the automatic transmission (temperature limit switch) reach control unit **15** via inputs **38** to **40**.

A signal from pressure sensor **25** in the coolant circuit of the air conditioner is connected to an input **41**; this sensor is designed as a continuously operating pressure sensor. Finally an input **42** is connected with hood contact switch **28**.

The fan blower, driven by an electric motor, is installed in the circuit as a dual electric fan with two drive motors **43** and **44** and electronic end stages **45, 46** which is done, as far as the end stages are concerned, for redundancy purposes and, as far as the electric fans are concerned, for reasons of improved spatial arrangement. Of course the functional reliability of the circuit is ensured even with a simple design.

A drive motor **43, 44** and an electronic end stage **45, 46** are connected in series and connected in parallel to the load power supply; end stages **45** and **46** are likewise connected in parallel on the control side.

The electronic end stages **45, 46** preferably receives a release signal, via an output **47** of control device **15** in certain embodiments which may also be deleted.

Electronic end stages **45, 46**, which are designed in the form of semiconductor switches, obtain a scannnng ratio via an output **48** of control device **15** in the form of a pulse-wide-modulated square-wave signal. The blower control can also be designed so that the scanning ratio is generated in electronic end stages **45, 46** and control device **15** generates only a corresponding analog or digital signal.

Finally, a return line runs from electronic end stages **45, 46** to an input **49** of control device **15**, via which a signal can be delivered to the latter to indicate whether an error exists in the supply circuit to the end stage (short circuit, lead broken) or whether it is defective. Finally, the electronic end stages also have connections for an operating power supply (positive terminal **50, 51**, ground **52, 53**) for the electronics, ground **54, 55** for the supply circuit (semiconductor switches) and one output **56, 57** each for a free-running diode integrated into the end stage but not shown.

Electric motor **12**, which serves to drive the cooling air flaps and is provided with the drive is controlled by control unit **15** via a relay **58** and control disk **14** which is nonrotatably connected with a (symbolically shown) output shaft **59** of transmission **13**. Electric motor **12** has one of its terminals connected to ground; the other terminal is supplied via a moving contact **60** of relay **50** in the controlled state with the positive terminal (+) and hence with operating voltage. In the noncontrolled state, moving contact **60** is connected to ground, so that the armature winding of motor **12** is short-circuited and a braking action is achieved. Sliding contacts **60** to **64**, which are mounted in a fixed manner, have a frictional connection with control disk **14** which is made circular; control disk **14** has a circular contact path **65** with which the first sliding contact **61** is in electrically conducting contact on an inner path **66**, the second sliding contact **62** is in contact on a middle path **67**, and the third and fourth sliding contacts **63** and **64** are in contact on an outer path **68**. In the area of the inner (**66**) and outer (**68**) circular paths of contact path **65**, an insulating surface **69**, **70**, which becomes effective within a limited rotational angle range, is located which interrupts the electrical connection between contact path **65** and the first **61**, third **63**, and fourth **64** sliding contacts.

The first, third, and fourth sliding contacts **61**, **63**, **64** are connected with outputs **71**, **72**, **73** of control device **15**, by which the cooling air flaps can be controlled to assume a closed (xk0=0%), partially open (xk1=30%), and fully open (xk2=100%) position xk. The second sliding contact **62** is in the exciting circuit of relay **58**, whose exciting winding **74** is connected on one side permanently to the positive terminal (+) of battery **33**.

The functioning of the system is explained as follows:

Starting with the position shown, in which the cooling air flaps are closed, we will presume for example, that the partially open position is to be assumed. Control device **15** for this purpose connects output **72** to ground potential which is transmitted by third sliding contact **63** via contact path **65** to second sliding contact **62**, so that exciting winding **74** of relay **58** is connected on one side to ground and on the other side to the positive terminal (+). Relay **58** pulls in, whereupon electric motor **12** and control disk **14** with it (and of course the cooling air flaps as well) are set in motion (rotary motion counterclockwise). The rotary motion is continued until insulating area **70** assumes an angular position in which fixed third sliding contact **63** is located; here it breaks the conducting link between third sliding contact **63** and contact strip **65** so that relay **74** drops out and the motor is braked to a stop. The fully open position and the closed position are reached by appropriately controlling the first **61** and fourth **64** sliding contacts. The adjustment from one position to another as a result of the fixed single direction of rotation is always in the following sequence: closed—partially open-fully open—closed.

The control of the individual positions is subject to time limitations: it is designed so that it is just sufficient for each adjustment process under the most difficult conditions. In this way, overloads on the drive are avoided and it is also possible to eliminate any need for position feedback.

Control device **15**, which preferably uses known microcomputer technology, can also be made capable of self-diagnosis and may include an electrically erasable memory area in which error messages from the microcomputer can be stored; as described, for example, in German OS No. 35 40 599, these messages can be called up in a diagnostic process by a diagnostic system.

The control device is connected for this purpose via inputs/outputs **75**, **76** with a communications lead K and an exciting lead L. Provision is also made for the fact that when an emergency function triggered for example by the failure of a sensor, appears, a warning light **77** is triggered on the control panel of the motor vehicle by a central processing unit **78**, which obtains a signal via an output **79** of the control unit. When the emergency function cuts in, the flaps are simultaneously completely opened and the blower is run at maximum rpm. In addition, a position feedback can be provided by sliding contacts **61** to **64** and warning light **77** can be triggered if desired.

The function of the cooling air flap and blower control will now be described with reference to the graphs in FIGS. **3** to **10**.

FIG. 3 initially shows the dependence xk=fkt(tm) of the cooling air flap position xk on engine temperature tm. Flap position xk is expressed as a percentage with value xk0=0% corresponding to the closed position, the value xk1=30% of the partially open position, and the value xk2=100% to the fully open position. The engine temperature here is expressed in degrees Centigrade (°C.).

With rising engine temperature values tm, the cooling air flaps initially remain closed until a first temperature threshold tmg1 is reached, which here would be assumed to be 79° C. Above this threshold value, flaps **10** will be moved into the partially open position xk1 for constantly rising values of engine temperature tm, which position is retained until a second temperature threshold tmg2 is reached. Above this second temperature threshold tmg2, which here we will assume to be 85°, the flaps will be fully opened. If the engine temperature tm drops again, the cooling air flaps will remain in the fully open position xk2 until the first temperature threshold tmg1 is reached, and then move into their partially open position xk1. This in turn is retained down to a third temperature threshold tmg3 (assumed to be 74° C.) and the closed position xk0 will be triggered as the temperature continues to fall below tmg3.

FIG. 4 shows the relationship μg=fgt(tm) of the scanning ratio to the control of fan blower **18**, **43**, **44** as a function of engine temperature tm. However, it is not the scanning ratio itself which is plotted on the ordinate of the graph as the controlling value but the voltage μg, scaled in volts, which appears at the terminals of the fan at a certain scanning ratio. Up to a first temperature threshold tmg1 the blowers are operated for increasing values of engine temperature tm up to the second temperature threshold tmg1 with a voltage μg which increases linearly with temperature from μg1=6 volts to μg2=9 volts. When the second temperature threshold tmg2 is reached, voltage μg is lowered from μg2=9 volts to μg3=7 volts, to be raised to the full onboard line voltage of μg max=12 volts at higher values of the engine temperature tm up to a fourth temperature threshold tmg4; above this value the control voltage of μg max=12 volt is retained.

For falling temperatures, the control curve initially runs downward to the second temperature threshold tmg2 equivalent to that for rising temperatures. Below the second temperature threshold tmg2 the voltage μg3=7 volts is maintained down to the first temperature threshold tmg1 and when the first temperature threshold is reached, it drops to μg1 =6 volts. This control is maintained down to a fifth temperature threshold tmg5 (at 77° C.) Below the fifth temperature threshold tmg 5, the blower is no longer controlled to operate.

The special nature of the control curve shown in FIG. 4 lies in the fact that the voltage μg for controlling the blowers is lowered by approximately 2 volts precisely when the cooling air flaps are moved from their partially open position xk1=30% to their fully open position xk2=100%. The lowering of the blower voltage μg and the resultant lowering of the blower rpm means that in the temperature interval between first temperature threshold tmg1 and fourth temperature threshold tmg4, despite the intermediate opening of the cooling air flaps by about 70%, a cooling air stream which increases continuously with engine temperature tm is obtained in the cooling air duct. By avoiding a cooling air stream that changes abruptly, a good regulating behavior is obtained and continuous switching back and forth between the partially and fully open cooling air flap positions is avoided.

Finally, FIG. **5** shows a control curve (xk=fkp(p)), which shows the cooling air flap position xk in percent as a function of pressure p of the coolant in the air conditioner (measured in bars). Above a first pressure threshold pgl of about 3.5 bars the flaps are moved into partially open position xk**1**. This position is maintained up to a second pressure threshold pg**2** at about 15 bars and raised to 100% for higher pressures p. If pressure p drops off again, the cooling air flap position xk will remain at 100% up to a third pressure threshold pg**3** (12 bars) and is then adjusted to 30% down to a fourth pressure threshold pg**4** (3 bars). Below the fourth pressure threshold value pg**4**, which is at about 3 bars, the flaps remain closed.

FIG. **6** again shows the voltage μg (in volts) of the blower as a function $\mu g=fgp(p)$ of pressure p. For rising pressures, the blower is initially not controlled up to a first pressured threshold pgl. Above pressure threshold pgl and up to a second pressure threshold pg**2**, control is accomplished with a voltage $\mu g4$ of about 8.5 volts, which is raised above the second pressure threshold pg**2** up to a fifth pressure threshold pg**5** (at about 19 bars) linearly up to the maximum onboard line voltage of μg max=12 volts; here it remains for higher pressures p. For falling pressures p the control curve $\mu g=fgp(p)$ runs parallel with that for rising pressures and remains at a voltage of $\mu g4=8.5$ volts down to below the first pressure threshold pg**l**. Below a fourth pressure threshold pg**4** at about 3 bars the blower is switched off once again.

FIGS. **5** and **6** also show hysteresis characteristics which serve primarily to smooth the flap control. It should be pointed out at this juncture that the control curves shown in FIGS. **3** to **6** are effective only when the ignition is switched on; likewise control according to FIGS. **5** and **6** as a function of pressure p is provided only when the air conditioner switch is actuated.

In the preferred illustrated embodiment the control of the fan flaps or blower always produces the same control curves (shown in FIGS. **3** to **6**) which momentarily imply the highest control value; i.e., whenever any control variable would indicate a higher control value, that higher control value is implemented.

FIGS. **7** to **10** show additional control curves for the flap position or blower. The control curves shown in FIGS. **7** and **8** are active only when the ignition is switched on while the control curves in FIGS. **9** and **10** are effective only when internal combustion engine **2** is switched off; the fan blower shown in FIG. **10** is controlled only when engine hood **29** is closed.

In FIGS. **7** and **8** the cooling air flap position xk and blower voltage μg are displayed as a function of the temperature tg of the lubricant in the transmission. Below a temperature tgg of 105° there is no control of the ventilation flaps or blower. For temperature values tg higher than or equal to tgg=105° C. the cooling air flaps are controlled in their partially open position xk**1** and the blower is operated with a voltage $\mu g4$ of about 8.5 volts. According to FIG. **9**, the cooling air flaps, with the engine shut off, are fully opened xk**2**—100% only when either the temperature ts in the internal combustion engine intake manifold is above a temperature threshold tsg of 82.5° C. or the temperature of the internal combustion engine rises above a temperature threshold tmg**6** of 80° C. In addition, according to FIG. **10**, the fan blower is operated with a voltage μg of $\mu g1=6$ volts above these temperature thresholds tsg, tmg**6** of ts or tm with engine hood **29** closed. However, it is also contemplated in certain embodiments not to control cooling air flaps **10** according to FIG. **9** when internal combustion engine **3** is shut off, but always to keep them fully open.

Finally, FIG. **11** shows examples of a scanning ratio signal in a graph showing voltage as a function of time, as used to control electronic end stages **45**, **46**. One minimum and one maximum scanning ratio signal are shown, each of which corresponds to an equivalent DC voltage drop at the terminals of the blower of 6 volts and 12 volts. The maximum onboard line voltage is assumed here to be 12 volts; but in the case of motor vehicles equipped with lead storage batteries, it can also be 13.2 volts. It should also be pointed out at this juncture that the two end stages **45**, **46** are scanned, staggered one half scanning period apart, so that the noise voltage load scan also be kept low.

Although the present invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only, and is not to be taken by way of limitation. The spirit and scope of the present invention are to be limited only by the terms of the appended claims.

What is claimed is:

1. A cooling air control system for motor vehicles of the type having cooling air duct means opening to an engine copartment, comprising:

controllable cooling airflap means for controlling the size of the flow opening in the cooling air duct means;

controllable speed fan means for controlling the flow of air supplied by the cooling air duct means;

electric motor driven airflap control means for controlling the airflap means in response to detected cooling air requirements to selectively move the same; to a closed position, a partially open position or a fully open position; and

rotational speed control means for controlling the rotational speed of the fan means in response to detected cooling air requirements starting in the partially open position of said airflap means.

2. A system according to claim **1**, further comprising cooling air requirement detecting means for detecting cooling air requirements.

3. A system according to claim **2**, wherein said cooling air requirement detecting means includes means for detecting at least two of (i) engine coolant temperature; (ii) air conditioner refrigerant pressures; (iii) vehicle transmission fluid temperature; and (iv) vehicle engine intake manifold temperature.

4. Cooling air flap and blower control for motor vehicles whose engine compartment is exposable to a cooling air stream by at least one opening terminating in a cooling air duct in the body, whereby the cooling air duct is closable by cooling air flaps whose position can be controlled and at least one heat exchanger and at least one blower with a controllable rotational speed (rpm) are disposed in the cooling air duct, and the position of the cooling air flaps and the rpm of the blower are controllable by a contorl means as a function of a cooling requirement of systems of the motor vehicle such that when the cooling requirement increases the cooling air flaps are intially moved into an open position and as the cooling air requirement rises further, the blower is additionally controlled, wherein said control means controls an electric motor to move said cooling air flaps, depending on the cooling requirements, to a closed position (zk=kz0), a partially open position (sk—zk2) and a fully open position, and controls the rpm of said blower, starting in the partially open position of said cooling air flaps so that a cooling air stream which changes approximately continuously proportionally with the cooling requirements is obtained in a cooling air duct.

5. Cooling air flap and blower control according to claim **4**, wherein the cooling requirements are derived from at least one of the following values:

temperature (tm) of a coolant in an internal combustion engine;

pressure (p) in a coolant circuit of an air conditioner; and

temperature (ts) of an intake manifold of the internal combustion engine, whereby when the cooling requirement is determined by more than one value, that value is used for control which implies the highest controlling value (xk, μg) for cooling air flaps or blower.

6. Cooling air flap and blower control according to claim **5**, wherien said control means includes control curves (xk=fkt(tm), xk=fkp(p), μg=fgt(tm), μg=fgp(p)), which have hysteresis defining:

cooling air flap adjustment (xk0 as a function of temperature (tm) or pressure (p); and

motor drive voltage value (μg) set by a scanning ratio to control blower as a function of temperature (tm) and/or pressure (p) and the voltage values (μg) which increase of themselves along with the independent variables, (tm), at least in control curve (μg=fgt(tm)), are lowered by a certain amount at that temperature (tm) at which cooling air flaps swivel from partially open position (sk1) to fully open position (xk2).

7. Cooling air flap and blower control according to claim **6**, wherein some control curves (xk=fkt(tm), xk=fkp+(p), μg=fgt(tm), μg=(FGP(p)) are effective only when the ignition is switched on and some control curves (xk=fkp(p), μg=fgp(p)) are effective only when air conditioner is switched on.

8. Cooling air flap and blower control according to claim **7**, wherein cooling air flaps (**10**) are fully open when ignition is switched off.

9. Cooling air flap and blower control according to claim **8**, wherein one of said control curves (xk=fkt(tm))**13** with rising temperature;

assumes a value (xk=xk0) for the closed position (xk0) of cooling air flaps as long as temperature (tm) is less than a first temperature threshold (tmg1);

assumes a value (xk=xk1) for the partially open position as long as temperature (tm) is greater than or equal to first temperature threshold (tmg1), but is still below a second temperature threshold (tmg2);

with dropping temPerature (tm), remains at this control value (xk=xk2) as long as temperature (tm) has not yet fallen to first temperature threshold (tmg1); and

beyond this value, assumes the value (xk=xk1) for the partially open position (xk1) as long as temperature (tm) has not yet dropped to a third temperature threshold (tmg3), and beyond this value, assumes the value (xk=xk0) for the closed position.

10. Cooling air flap and blower control according to claim **9**, wherein one of said control curves (μg=fgt(tm));—with rising temperature (tm)

produces no control of blower as long as temperature (tm) remains below first temperature threshold (tmg1);

assumes a voltage value (μg) which increases linearly between first voltage value (μg1) and a second voltage value (μg2) so long as temperature (tm) is higher than or equal to first threshold (tmg1), but is still below second temperature threshold (tmg2);

on reaching second temperature threshold (tmg2), at which cooling air flaps swivel from the partially open into the fully open position, lowers the voltage (μg) to a third voltage value (μg3), whereby when temperature (tm) increases further, the voltage (μg) is increased linearly until it reaches a value (μg. max.) for the maximum onboard line voltage when a fourth temperature threshold (tmg4) is reached, and retains the latter;—with falling temperature (tm)

starting at a value of temperature (tm) above fourth temperature threshold (tmg4);

initially moves following the same curve until it reaches a second temperature threshold (tmg2);

then remains at third voltage value (μg3) between second temperature threshold (tmg2) and first temperature threshold (tmg1);

on reaching first temperature threshold (tmg1) lowers the voltage value (μg) to the first voltage value (μg1), at which it remains until it drops to a fifth temperature threshold (tmg5) beyond which no further control of blower is effected.

11. Cooling air flap and blower control according to claim **10**, wherein one of said control curves (xk=fkp(p))—with rising pressure (p);

for pressure values (p) is lower than a first pressure threshold (pg1) at the value (xk0) for the closed position of the cooling air flaps, for pressure values (p) is above or equal to first pressure threshold (pg1), but below a second pressure threshold (pg2) at value (xk1) for the partially open position of the cooling air flaps and for pressure values (p) is higher than second pressure threshold (pg2) at the value (xk2) for the fully open position of cooling air flaps, and—for falling values of pressure (p);

from a value above second pressure threshold (pg2) down to a third pressure threshold (pg3) located below second pressure threshold (pg2), remains at value (xk2), for pressure values (p) below or equal to the third pressure threshold (pg3), but higher than a fourth pressure threshold (pg4) located below first pressure threshold (pg1), is at value (xk1) and for pressure values (p) below or equal to fourth pressure threshold (pg4) is at value (xk0) for cooling air flaps.

12. Cooling air flap and blower control according to claim **11**, wherein one of said control curves (μg=fgp(p))—with rising pressure (p);

for pressure values (p) below a first pressure threshold (pg1) causes no control of blower;

for pressure values (p) above or equal to first pressure threshold (pg1), but below or equal to second pressure threshold (pg2), runs at a fourth pressure value (μg4);

for pressure values (p) above or equal to second pressure threshold (pg2), but below or equal to a fifth pressure threshold (pg5) located above second pressure threshold (pg2) increases linearly from fourth voltage value (μg4) up to voltage value (μg