(54) Title of the Invention: A brake booster system

Abstract Title: Detecting fault in second vacuum source of brake booster and then restricting systems that draw power from the engine

(57) Detecting a fault within a brake boost system of a vehicle having an inlet manifold for an engine, which provides a first source of vacuum for the brake boost system, and a second source of vacuum, preferably a super aspirator. The pressure of a brake boost chamber and the pressure of an inlet manifold for an engine of the vehicle when the secondary vacuum source is active is measured and compared to determine whether the secondary vacuum source is faulty. If the second vacuum source is faulty the use of a first auxiliary electrical and/or mechanical system which draws power from the engine is restricted so as to reduce and/or maintain the pressure of the inlet manifold. The auxiliary systems may include an alternator charging a battery and/or an air condition system. The engine power may also be restricted. The restriction is removed when it is no longer required.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
START

300

Determine whether super aspirator is required.

302

Y

Send instruction to open super aspirator.

304

N

Send instruction to close super aspirator.

306

WAIT

308

Is Brake Booster pressure ≈ MAP

Y

Indicate Fault

N

Determine whether super aspirator is still required.

310

312

314

To Fig. 3b

Figure 3a
From Fig. 3a

316
Restrict Battery charging if possible

318
WAIT

Is Brake Booster pressure < Threshold pressure

320
N
Restrict Air conditioning if possible

322
Determine whether Additional vacuum is still required.

324
Y
Remove restrictions in place

326
N
Check for reset

328
WAIT

Is Brake Booster pressure < Threshold pressure

330
N
Restrict Engine power

332
Y

334
WAIT

Is Brake Booster pressure < Threshold pressure

336
N
Increase Engine Power restriction if possible

340
N

Figure 3b
A BRAKE BOOSTER SYSTEM

Technical Field

5 The present disclosure relates to a brake booster system for a motor vehicle and is particularly, although not exclusively, concerned with a brake booster system configured to detect failure of a vacuum source and respond to protect brake booster vacuum.

10 Background

Most modern vehicles are fitted with a brake booster which uses a vacuum chamber to increase the braking force supplied from the brake pedal to the brake master cylinder. The brake booster prevents the brake pedal from feeling heavy to the driver.

15 The brake booster requires a source of vacuum pressure in order to operate, which, in naturally aspirated engines, is often delivered exclusively by the inlet manifold. In some circumstances, the vacuum supplied by the inlet manifold is insufficient. This may be due to the inlet throttle being fully open and hence inlet manifold vacuum may be low.

20 In order to maintain the brake booster vacuum under these conditions, an additional vacuum source must be used, such as a super aspirator. A super aspirator often takes the form of a venturi duct connected between the intake duct and inlet manifold across the inlet throttle. The pressure difference across the throttle drives a flow through the venturi allowing a lower pressure to be achieved within the venturi. This can in turn be used to provide a lower pressure in the brake booster vacuum chamber compared to the inlet manifold pressure.

In some cases, sufficient pressure difference may not be available for a venturi duct to operate effectively, and a separate pump may be required to provide a vacuum source. Whatever form the vacuum source takes, a shut-off valve is often added which is opened only when insufficient vacuum is present in the brake booster and/or inlet manifold. The shut-off valve is often controlled by the engine's power-train control module and is normally in a closed position unless activated.
In the case that the super aspirator itself or the electronic shut-off valve fails, sufficient vacuum pressure may not be available within the brake booster and the brake pedal may begin to feel heavy. A heavy brake pedal provides a less comfortable driving experience and may lead drivers to believe that braking performance is impaired. Hence it is desirable to limit faults of this kind.

**Statements of Invention**

According to an aspect of the present disclosure there is provided, a method for detecting a fault within a brake boost system of a vehicle, the vehicle comprising an inlet manifold for an engine, the inlet manifold providing a first source of vacuum for the brake boost system, the vehicle further comprising a second source of vacuum for the brake boost system, wherein the method comprises: measuring the pressure of a brake boost chamber and the pressure in the inlet manifold when the secondary vacuum source is instructed to be active; comparing the measured brake booster chamber and inlet manifold pressures; determining whether the secondary vacuum source is faulty. The method may further comprise restricting the use of a first auxiliary electrical and/or mechanical system which draws power from the engine in the case of a fault so as to reduce and/or maintain the pressure of the inlet manifold.

Determining whether the secondary vacuum source is faulty may comprise determining if the measured brake booster chamber pressure is equal, e.g. substantially equal, to the measured inlet manifold pressure.

The method may further comprise restricting the use of a second auxiliary electrical and/or mechanical system which draws power from the engine. Additionally or alternatively, the method may further comprise restricting the power of the engine.

The first auxiliary electrical and/or mechanical system may comprise an air-conditioning system for the vehicle or a battery charging system for the vehicle. The second auxiliary electrical and/or mechanical system may comprise an air-conditioning system for the vehicle or a battery charging system for the vehicle.

The method may further comprise waiting for a predetermined period after applying a restriction; and determining whether the brake booster chamber pressure is at or below a threshold value before applying any further restrictions.
The method may further comprise removing a restriction when it is no longer required, e.g. when additional vacuum is no longer required.

The method may further comprise indicating the failure of the secondary vacuum source to a driver of the vehicle.

The pressure of the inlet manifold may be maintained substantially at or below a target vacuum, such as -20kPa, -30kPa or -40kPa, relative to atmospheric pressure.

The secondary vacuum source may comprise a super aspirator.

According to another aspect of the present disclosure, there is provided a system for detecting a fault within a brake boost system of a vehicle, the vehicle comprising an inlet manifold for an engine, the inlet manifold providing a first source of vacuum for the brake boost system, the vehicle further comprising a second source of vacuum for the brake boost system, wherein the system comprises one or more controllers configured to carry out any of the above-mentioned methods.

According to another aspect of the present disclosure, there is provided software, which when executed by a computing apparatus causes the computing apparatus to perform any of the above-mentioned methods.

According to another aspect of the present disclosure, there is provided a vehicle comprising the above-mentioned system for detecting a fault within a brake boost system of the vehicle.

**Brief Description of the Drawings**

For a better understanding of the present disclosure, and to show more clearly how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a schematic diagram of an engine, control system and brake system of a vehicle fitted with a brake booster system;
Figure 2 is a schematic view of a brake booster assembly for a vehicle according to an example of the present disclosure; and

Figures 3a and 3a show a method for reporting a brake booster failure whilst maintaining brake feel according to an example of the present disclosure.

**Detailed Description**

With reference to Figure 1, a typical vehicle including a brake booster system is described. The vehicle may comprise an engine 10, a brake system 50 and a control system 100.

The engine 10 may comprise a plurality of cylinders 12 and corresponding pistons 28. Air flow into and out of each of the cylinders 12 may be controlled through the use of inlet and outlet valves 14, 16 respectively.

The engine 10 may comprise an inlet 20 which allows air to be drawn into the engine. The engine 10 may further comprise a turbocharger 22. Typically, the turbocharger comprises a compressor 22a which is arranged with an exhaust driven turbine 22b driving the compressor 22a on the same shaft. The turbocharger 22 may improve the engine power output and emissions.

Air may enter the engine 10 through inlet 20 and be passed through the compressor 22a. Air which has been compressed by the turbocharger compressor 22a may be throttled by an inlet throttle 19 before being delivered to an inlet manifold 18.

Due to the presence of the inlet throttle 19, and also through the action of the engine pistons 28 drawing air from the inlet manifold into the engine cylinders 12, the inlet manifold 18 may be at a lower pressure than air entering via the inlet 20, i.e. there may be a vacuum present within the inlet manifold 18. The level of manifold vacuum may be reduced as the throttle is opened, and/or the turbocharger compressor 22a is driven by the turbocharger turbine 22b to boost the pressure of the inlet air.

The pressure of the air in the inlet manifold 18 may be measured by a manifold air pressure (MAP) sensor 32. Inlet manifold pressure is an input parameter for the control system 100 and may be used to determine the amount of fuel injected into the engine.
cylinders 12. Additionally or alternatively, the manifold pressure value may be used to
determine the expected performance of any systems which use the inlet manifold as a
vacuum source.

The inlet manifold 18 is disposed adjacent to the inlet valves 14, allowing air within the
inlet manifold 18 to be drawn into the cylinders 12 when their respective inlet valve 14
is open. In the cylinders 12 fuel is mixed with the air and combusted.

Mechanical power is developed in a crankshaft 30 and used to drive the vehicle and to
power an alternator (not shown), which charges a battery for the vehicle. The battery
or mechanical power of the crankshaft may power ancillary systems of the vehicle.
Such systems may include air conditioning, cabin heating, windscreen heating, a
stereo system and/or any other electrical and/or mechanical system.

Combustion gases are exhausted from the cylinder 12 via outlet valve 16 into an
exhaust manifold 24. Exhaust gases within the manifold 24 may then pass through
turbocharger turbine 22b before being exhausted through exhaust pipe 26.

The brake system 50 may comprise a brake pedal 54, a brake booster 56 and a brake
master cylinder 59. The brake booster 56 may be configured to amplify the force
provided by a foot 52 on the brake pedal 54.

Amplification of the applied braking force may be achieved through the use of a
negatively pressurised brake booster chamber 58 which includes a diaphragm (not
shown). When the brake pedal 54 is pushed, the diaphragm is exposed to atmospheric
air on one side, whilst the other side is exposed to the vacuum pressure within the
brake booster chamber 58. This pressure difference across the diaphragm may be
used to provide additional braking force to the brake master cylinder 59.

Using a brake booster to amplify the supplied braking force in this way has the effect of
a lighter feeling brake pedal, as the driver need not push as hard to achieve the desired
level of braking.

The brake booster 56 may be connected via an air line 60 to the inlet manifold 18. The
brake booster 56 may be charged with vacuum pressure from the inlet manifold 18 via
the air line 60. A check valve 62 may be included in the air line 60 to ensure flow of air
is from the brake booster 56 to the inlet manifold 18 only. This allows vacuum pressure in the brake booster chamber 58 to be maintained through conditions when inlet manifold pressure is higher than the brake booster chamber pressure.

A brake booster pressure sensor 68 may be provided within the brake booster chamber 58 to determine the vacuum pressure level.

When the turbocharger 22 is operating and/or the inlet throttle 19 is open, the inlet manifold pressure may be too high to provide an adequate vacuum source. Accordingly, one or more additional vacuum sources 64 may be provided for the brake booster 56. The additional vacuum source may comprise an electrically driven vacuum pump, however, it is equally envisaged that the additional vacuum source 64 may comprise a mechanically driven pump, a venturi device or any other suitable pump capable of producing a vacuum. The additional vacuum source 64 may comprise one or more pumps and/or venturi devices.

A control valve 66 may be provided to control the operation of vacuum source 64. The control valve may be electronically or pneumatically controlled. The control valve 66 may generally be in an off position and may be switched on by the control system 100 when the pressure reading from brake booster pressure sensor 68 rises above a desirable level.

In the example shown in Figure 1, if a fault occurs with either the vacuum source 64 or the control valve 66, pressure in the brake booster chamber 58 cannot be reduced below the pressure of the inlet manifold 18. If the inlet manifold vacuum is poor, i.e. the inlet manifold pressure is not sufficiently low, the vacuum within in the brake booster chamber 58 may drop below the desired level, this could lead to the brake pedal 54 feeling heavy to the driver.

A heavy brake pedal feeling may become noticeable at brake booster vacuum levels less than a target vacuum below atmospheric pressure. The target vacuum may be approximately -20kPa, -30kPa or -40kPa relative to atmospheric pressure. Due to the heavy brake pedal feeling, this type of issue can be uncomfortable for a driver.
With reference now to Figure 2, a brake booster system according to an example of the present disclosure comprises, the control system 100 and a brake system 200 provided within the vehicle 1.

In the example shown in Figure 2, the engine 10 comprises a naturally aspirated petrol engine, however it is equally envisaged that the present disclosure could apply to a diesel engine. Additionally or alternatively the engine could comprise a turbocharger or supercharger. In some embodiments, the vehicle 1 may additionally comprise an additional motor, such as an electric motor, and the engine 10 may be part of a hybrid drive system.

The naturally aspirated engine 10 also comprises the inlet 20, throttle 19 and intake manifold 18 described above.

In the example shown in Figure 2, the additional vacuum source 64 comprises a super aspirator 201. The super aspirator is a venturi device and comprises an inlet side 201a, an outlet side 201b and a narrowing or throat 201c. The inlet side 201a is connected to the inlet duct 20 of the engine 10 via inlet line 206. An outlet line 208 connects the outlet side 201b to the inlet manifold 18 of the engine 10.

As described above, when the engine 10 is operating, there may be a reduced pressure within the inlet manifold 18 relative to the inlet 20. Air may therefore be drawn through the super aspirator from the higher pressure inlet 20 to the lower pressure inlet manifold 18. When a flow of air is present through the super aspirator, the pressure within the venturi of the super aspirator 201 may be lower than at either the inlet side 201a or the outlet side 201b.

A vacuum pipe 220 may be connected to the super aspirator 201 between the inlet end 201a and the outlet end 201b. The vacuum pipe may be in fluidic communication with the flow through the super aspirator venturi. The vacuum pipe 220 may be connected at the location where pressure in the venturi is lowest, for example at the throat 201c.

The vacuum pipe 220 may also be connected (directly or indirectly) to the brake booster chamber 58. When the super aspirator is operating, the brake booster chamber may thus be at a higher vacuum level than the inlet manifold 18. A super aspirator check valve 216 may be provided between the brake booster chamber 56 and the super
aspirator 201 to allow the vacuum to be retained within brake booster 56 when the super aspirator 201 is not operating.

Operation of the super aspirator may be controlled by a shut-off valve 202. The shut-off valve may comprise a ball valve, a butterfly valve, or any other valve capable of selectively permitting flow through the super aspirator. The shut-off valve may be controlled by the control system 100 via a signal line 204. The shut-off valve may be positioned within the super aspirator and may be positioned at the inlet or the outlet of the super aspirator. Alternatively, the shut-off valve may be positioned between the inlet and the outlet of the super aspirator, for example at the throat 201c. Alternatively, the shut-off valve may be positioned upstream of the super aspirator, e.g. on the inlet line 206, or downstream of the super aspirator, e.g. on the outlet line 208. The shut-off valve 202 may close to prevent the flow of air through the super aspirator when additional vacuum is not required. For example, when a sufficient level of vacuum is available from the inlet manifold 18 and the super aspirator is not required.

When the additional vacuum source 64 comprises the super aspirator 201, as shown in Figure 2, the vacuum line 60 may still be provided to enable the brake booster chamber 56 to be charged with vacuum pressure from the inlet manifold when desirable, i.e. when a sufficient level of vacuum is available from the inlet manifold 18. If the vacuum line 60 is provided, the check valve 62 may also be provided as described above.

As depicted in Figure 2, the brake booster 56 further comprises the pressure sensor 68 which may connected to an anti-lock braking system (ABS) module 212 via a brake vacuum signal cable 218. The ABS module may be connected to the control system 100 via a data bus 214, which may comprise a controller area network (CAN) bus. Alternatively the data bus may comprise any other suitable data bus. The control system 100 may thus be configured to monitor brake booster vacuum levels. In an alternative embodiment, there may be no ABS Module and/or the brake vacuum signal cable 218 may be connected directly to the control system 100.

With reference to Figure 3a, the control system 100 may perform a control and monitoring process 300. The process 300 may be performed by a single controller. Alternatively, the process 300 may be performed by more than one controller or module, each performing part of the process 300.
Once the process is started, in step 302 the system may determine whether the super aspirator is required. For example, the system may compare the pressure of the brake booster chamber 58 to a desired pressure selected to provide optimal feel of the brakes. If the system determines that the super aspirator is not required, the process may return to the start of the process. The process will therefore continue to monitor the requirement for the super aspirator.

If in step 302, the system determines that the super aspirator is required, the process precedes to step 304 in which the super aspirator is instructed to begin operating. For example the shut-off valve 202 of the super aspirator may be instructed to open.

At the point when the super aspirator is instructed to turn on, the brake booster pressure may be substantially the same as the inlet manifold pressure since the inlet manifold pressure may previously have been acting as the vacuum source for the brake booster. Once the super aspirator has been instructed to start operating, the pressure of the brake boost chamber may be expected to reduce relative to the inlet manifold pressure. In step 306, the process may wait for a predetermined period of time to allow the super aspirator to begin lowering the brake booster pressure before proceeding to step 308.

In step 308 the process compares the inlet manifold pressure with the brake booster pressure. Since the super aspirator has been instructed to operate for a period of time in step 306, the brake booster pressure may be expected to be below the inlet manifold pressure. If in step 308 the brake booster pressure is substantially the same as the inlet manifold pressure, or if the absolute pressure is not below a certain threshold, it may be determined that the super aspirator or super aspirator shut off valve is faulty. In this case the process may proceed to step 310 when the super aspirator fault may be indicated to the driver.

If in step 308 the brake booster pressure is not substantially equal to the inlet manifold pressure, it may be determined that the super aspirator is operating without a fault and the process may loop between steps 312 and 308 in order to monitor the operation of the super aspirator whilst it is still required. Once it is determined in step 312 that the super aspirator is no longer required, the process may proceed to step 314 in which the super aspirator is instructed to switch off (i.e. the shut-off valve 202 is instructed to close) and the process returns to the start.
With reference to Figure 3b, if a fault has been detected with the super aspirator, and indicated to the driver in step 310, the process 300 may begin to restrict the use of ancillary systems, such as one or more electrical and/or mechanical systems, and may thereby reduce load on the engine. Reducing the load on the engine may allow for increased throttling of the inlet air by the throttle 19, which may reduce the pressure within the inlet manifold 18. In step 316 the process acts to restrict a first ancillary system of the vehicle, for example a battery charger, if the restriction is possible. The restriction may not be possible, for example, if the controller deems the ancillary system to be essential to the functioning of the engine and/or vehicle at that point in time, e.g. if the battery level is below a threshold and requires charging. The process waits in step 318 to allow the inlet manifold pressure to be lowered due to the reduced load on the engine.

After waiting in step 318, the process proceeds to step 320 where the brake booster pressure is compared to a predetermined threshold pressure. The threshold pressure may be set at a desired level for maintaining a soft feel to the brake pedal. If the brake boost pressure is below the threshold pressure, i.e. there is sufficient vacuum within the brake boost chamber, the process may proceed to step 322. In step 322 the system considers whether is it necessary to maintain additional vacuum, i.e. to continue to provide vacuum pressure to the brake booster. This may be desirable, for example when the vehicle is braking, or is expected to brake. If additional vacuum is still required, the process returns to step 316 and continues to restrict ancillary systems. If in step 322 it is determined that additional vacuum is no longer required, in step 324 the system removes any restrictions which have previously been imposed and proceeded to step 326 where the system checks whether it has been reset, i.e. if the vehicle has been taken to a garage and repaired. The system may continue to loop between steps 322 and 326, such that if it becomes necessary to supply additional vacuum from the inlet manifold again, the process can return to step 316 to restrict the use of ancillary systems.

If in step 316 it is determined that it is not possible to restrict battery charging, for example if the battery is not currently being charged, the process may proceed to step 328 in which an alternative system, for example an air conditioning system of the vehicle is restricted. Similarly, if in step 320 it is determined that the restriction on battery charging has not reduced the brake booster pressure sufficiently, the system
may proceed to step 328 to restrict the alternative system in addition to restrictions already in place.

The steps 330 and 332 which follow from step 328 are similar to steps 318 and 320 which followed step 316 as described above. In step 330 the time the system waits may be the same as the time waited in step 318. Alternatively, the time may be different and may be specific to the restriction or restrictions which have been put in place by the system.

If in step 332 it is determined that the brake booster pressure is now below the threshold pressure, the system may proceed to step 322 as described above. Alternatively, if the brake boost pressure remains too high, the system may proceed to restrict the next system. Similarly, if it is determined in step 328 that the second ancillary system cannot be restricted, the system may proceed to restrict the next system.

In the example shown in Figure 3b, once the second ancillary system has been restricted, the system then proceeds to step 334 in which the power of the engine is directly restricted. However, it is equally envisaged that more ancillary systems may be restricted before the system begins to restrict engine power. It will be appreciated that a part 300a of the process may be repeated as desired and another system may be restricted, for example a stereo system of the vehicle, heated seats, heated windscreen and/or tailgate glass, and/or any other system which draws power from the engine directly or indirectly. The systems may be restricted in order of preference, e.g. restricting the least essential first.

Once all desired ancillary systems have been restricted, the process proceeds to step 334 as depicted in Figure 3b. In step 334 the power of the engine may be directly restricted, i.e. the throttle of the engine may be at least partially closed. This may have the effect of reducing the driving performance of the vehicle. Similar to the restrictions described above, the system may wait a pre-determined time in step 336 before comparing the brake booster pressure with a threshold value in step 338. If the brake booster pressure is below the threshold value the system may proceed to step 322 as described above. Alternatively, if the brake boost pressure is still above the threshold value, the system may consider in step 340 whether it is possible and/or desirable to restrict engine power further. If it is determined that the engine power may be restricted
further, the system returns to step 334 to implement the additional restriction. If further restriction of the engine power is determined to be not possible and/or not desirable in step 340, it may not be possible to lower the inlet manifold pressure further. The system may return to step 322 to continue monitoring whether the additional vacuum is still required.

As described above, in step 326, the system may await reset. For example, the vehicle may be taken to a garage where the super aspirator and/or shut-off valve is replaced or fixed and the system is manually reset. Additionally or alternatively, after a certain interval of engine running time, and/or engine or vehicle mileage, and/or engine revolutions, the control system may automatically reset and return to the start of the process 300 to determine whether the fault persists.

In the process 300 described above, by restricting the use of ancillary systems before limiting the mechanical power of the engine, the control system 100 of the vehicle does not necessarily affect the handling or performance of the vehicle until other options for preventing a hard feeling brake pedal have been attempted. In other words, the engine may be the last system to be restricted.

In addition to performing the process 300 during normal operation of the super aspirator, the control system 100 may test the super aspirator as a precaution, e.g. to ensure it is able to operate when required. For example, the control system may deliberately proceed to step 304 in the process even though the super aspirator may not be required. The system may therefore detect any fault present with the super aspirator or, if there is no fault, the process may proceed as normal to close the super aspirator and return to the start of the process. If a fault is detected during such a precautionary test, the system may indicate the fault to the driver, however, no restrictions of ancillary systems or engine power may be enacted at that point.

It will be appreciated that when it is determined that the super aspirator 201 is faulty, it may additionally or alternatively, be the shut-off valve 202 for the super aspirator which is faulty. In the context of this disclosure, a fault with the super aspirator or any vacuum source is considered to also comprise any fault with a control valve of the vacuum source.
Although the process 300 has been described assuming that only a super aspirator is used to provide vacuum pressure to the brake booster chamber, it is equally envisaged that a mechanically or electrically driven pump could be used, or any other pump suitable of providing a vacuum which can be controlled by an electronic controller. A combination of vacuum sources could also be used. The above-described methods and systems may be applied to such alternative vacuum sources.

It will be appreciated by those skilled in the art that although the invention has been described by way of example, with reference to one or more examples, it is not limited to the disclosed examples and that alternative examples could be constructed without departing from the scope of the invention as defined by the appended claims.
Claims

1. A method for detecting a fault within a brake boost system of a vehicle, the vehicle comprising an inlet manifold for an engine, the inlet manifold providing a first source of vacuum for the brake boost system, the vehicle further comprising a second source of vacuum for the brake boost system, wherein the method comprises:
   measuring the pressure of a brake boost chamber and the pressure in the inlet manifold when the secondary vacuum source is instructed to be active;
   comparing the measured brake booster chamber and inlet manifold pressures;
   determining whether the secondary vacuum source is faulty; and
   restricting the use of a first electrical and/or mechanical system which draws power from the engine in the case of a fault so as to reduce and/or maintain the pressure of the inlet manifold.

2. The method of claim 1, wherein determining whether the secondary vacuum source is faulty comprises:
   determining if the measured brake booster chamber pressure is substantially equal to the measured inlet manifold pressure.

3. The method of claim 1 or claim 2, wherein the method further comprises:
   restricting the use of a second electrical and/or mechanical system which draws power from the engine.

4. The method of any of the preceding claims, wherein the method further comprises:
   restricting the power of the engine.

5. The method according to any of the preceding claims, wherein the method further comprises:
   waiting for a predetermined period after applying a restriction; and
   determining whether the brake booster chamber pressure is at or below a threshold value before applying any further restrictions.

6. The method according to any of the preceding claims, wherein the method further comprises removing a restriction when it is no longer required.
7. The method of any of the preceding claims, wherein the first electrical and/or mechanical system comprises an air-conditioning system for the vehicle or a battery charging system for the vehicle.

8. The method of any of the preceding claims when dependant on claim 3, wherein the second electrical and/or mechanical system comprises an air-conditioning system for the vehicle or a battery charging system for the vehicle.

9. The method of any of the preceding claims, wherein the method further comprises:
   indicating the failure of the secondary vacuum source to a driver of the vehicle.

10. The method of any of the preceding claims, wherein the pressure of the inlet manifold is maintained substantially at or below a target vacuum relative to atmospheric pressure.

11. The method of any of the preceding claims, wherein the secondary vacuum source comprises a super aspirator.

12. A system for detecting a fault within a brake boost system of a vehicle, the vehicle comprising an inlet manifold for an engine, the inlet manifold providing a first source of vacuum for the brake boost system, the vehicle further comprising a second source of vacuum for the brake boost system, wherein the system comprises one or more controllers configured to carry out a method according to any of the preceding claims.

13. Software which when executed by a computing apparatus causes the computing apparatus to perform the method of any of claims 1 to 11.

14. A vehicle comprising the system for detecting a fault within a brake boost system of the vehicle according to claim 12.

15. A method for detecting a fault within a brake boost system of a vehicle substantially as described herein and with reference to Figures 3a and 3b.

16. A system detecting a fault within a brake boost system of a vehicle substantially as described herein with reference to and as shown in Figures 2, 3a and 3b.
Amendments to the claims have been filed as follows:

Claims

1. A method for detecting a fault within a brake boost system of a vehicle, the vehicle comprising an inlet manifold for an engine, the inlet manifold providing a first source of vacuum for the brake boost system, the vehicle further comprising a second source of vacuum for the brake boost system, wherein the method comprises:
   measuring the pressure of a brake boost chamber and the pressure in the inlet manifold when the secondary vacuum source is instructed to be active;
   comparing the measured brake booster chamber and inlet manifold pressures;
   determining whether the secondary vacuum source is faulty; and
   restricting the use of a first electrical and/or mechanical system which draws power from the engine in the case of a fault so as to reduce and/or maintain the pressure of the inlet manifold.

2. The method of claim 1, wherein determining whether the secondary vacuum source is faulty comprises:
   determining if the measured brake booster chamber pressure is substantially equal to the measured inlet manifold pressure.

3. The method of claim 1 or claim 2, wherein the method further comprises:
   restricting the use of a second electrical and/or mechanical system which draws power from the engine.

4. The method of any of the preceding claims, wherein the method further comprises:
   restricting the power of the engine.

5. The method according to any of the preceding claims, wherein the method further comprises:
   waiting for a predetermined period after applying a restriction; and
   determining whether the brake booster chamber pressure is at or below a threshold value before applying any further restrictions.

6. The method according to any of the preceding claims, wherein the method further comprises removing a restriction when it is no longer required.
7. The method of any of the preceding claims, wherein the first electrical and/or mechanical system comprises one of an air-conditioning system for the vehicle and a battery charging system for the vehicle.

8. The method of claim 7 when dependant on claim 3, wherein the second electrical and/or mechanical system comprises the other of an air-conditioning system for the vehicle or a battery charging system for the vehicle.

9. The method of claim 3, or any of claims 4 to 6 when dependant on claim 3, wherein the second electrical and/or mechanical system comprises an air-conditioning system for the vehicle or a battery charging system for the vehicle.

10. The method of any of the preceding claims, wherein the method further comprises:
    indicating the failure of the secondary vacuum source to a driver of the vehicle.

11. The method of any of the preceding claims, wherein the pressure of the inlet manifold is maintained substantially at or below a target vacuum relative to atmospheric pressure.

12. The method of any of the preceding claims, wherein the secondary vacuum source comprises a super aspirator.

13. A system for detecting a fault within a brake boost system of a vehicle, the vehicle comprising an inlet manifold for an engine, the inlet manifold providing a first source of vacuum for the brake boost system, the vehicle further comprising a second source of vacuum for the brake boost system, wherein the system comprises one or more controllers configured to carry out a method according to any of the preceding claims.

14. Software which when executed by a computing apparatus causes the computing apparatus to perform the method of any of claims 1 to 12.

15. A vehicle comprising the system for detecting a fault within a brake boost system of the vehicle according to claim 13.
16. A method for detecting a fault within a brake boost system of a vehicle substantially as described herein and with reference to Figures 3a and 3b.

17. A system detecting a fault within a brake boost system of a vehicle substantially as described herein with reference to and as shown in Figures 2, 3a and 3b.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

<table>
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<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
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<td>X</td>
<td>1-8 &amp; 10-14</td>
<td>JP 2005264874 A (TOYOTA MOTOR CORP.) especially see the abstract WPI AN 2005-653745, the figures noting secondary source of vacuum, ejector 214, and paragraphs 0012-0015 &amp; 0029-0050</td>
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- B60T, F02B, F02D, F02M

The following online and other databases have been used in the preparation of this search report:

- EPODOC, WPI

International Classification:

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