(54) Title: ANTI-THEFT DEVICES FOR MOTOR POWERED VEHICLES

Apparatus for immobilising an internal combustion engine in a land, water or airborne vehicle in which a closure device is located in the exhaust of the engine, within or downstream of the exhaust manifold which is movable into a blocking position in which the passage of exhaust gases from the engine is at least substantially prevented in response to the increase in pressure or temperature of the exhaust gases due to the running of the engine. The engine will thus start normally, if cold, and run normally until the exhaust gases cause the closure device to block the exhaust whereupon the engine will lose power and stop. A first device is provided which responds to an increase in pressure or temperature in the exhaust of the engine to move the closure device into its blocking mode and a second device is provided which counteracts the movement of the said first device in response to the vacuum generated at the vehicle inlet manifold. By providing an interlock mechanism, operable only by an authorised user of the vehicle, which mechanism prevents the vacuum from acting on the second device, unauthorised use of the vehicle will result in the engine starting but thereafter only running for a short time until the closure device moves to block the engine exhaust.
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*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.
Title: Anti-theft devices for motor powered vehicles

Field of invention

This invention concerns anti-theft devices for motor powered vehicles. By vehicles is meant any conveyance such as a car, lorry, bus, boat, hovercraft, aeroplane or railway engine which is powered by an internal combustion engine.

Background to the invention

Various alarms, ignition inhibiting systems and the like have been proposed to render car theft less easy. Most can be disabled relatively easily. Little has been done to make the theft of other vehicles such as motor powered boats less easy.

It is an object of the present invention to provide an anti theft device which is not noticeable, once activated is very difficult to disable, places little or no demands on the vehicle electrical system and which renders it virtually impossible for an unauthorised person to drive away a vehicle to which it is fitted.

Summary of the invention

According to the present invention a vehicle anti theft device comprises closure means movable to block or substantially block the engine exhaust path in response to a rise in temperature and/or pressure brought about by the
running of the vehicle engine and interactive means operable by an authorised user of the vehicle, to inhibit or nullify or cancel the blocking movement of the closure means.

The interactive locking means may be operated from within the vehicle by a button or lever which may be hidden and which itself may be operable only by means of a key or the entry of a code.

Alternatively the interactive means may be adapted to be operated automatically when a person carrying a particular coded device enters or boards the vehicle.

Alternatively, the interactive means may be adapted to operate automatically if a code is entered by the driver or authorised person at a particular time during the start up procedure either before, or after, the engine is started.

The closure means may be located at any point downstream of the exhaust valves of the engine and may be situated in or on the exhaust manifold or within a pipe leading therefrom to the exhaust and if fitted, silencer system, of the engine.

In a preferred embodiment of the invention the closure means comprises a pivotable flap which is rotatable by a drive means from a position in which the plane of the flap is substantially aligned with the direction of exhaust gas flow (thereby not to impede the flow) to a position in which the flap is substantially perpendicular to the said direction of gas flow to block the flow.
The drive means may be activated or derive motivating energy from the temperature or pressure rise of gases exhausting from the engine after start-up of the engine, and the interactive means determines a reference position for the said drive means and the latter is movable from a first position (in which movement of the drive means rotates the flap into the said blocking position) into a second position (in which movement of the drive means is either prevented or is in effective to rotate the said flap).

A preferred drive means, responsive to an increase in gas temperature, comprises a first capsule which is resiliently expansible and contains gas or a liquid or a combination thereof and which is heated by the exhaust gases. The interactive means may then comprise a similar second capsule which is resiliently contractible and is mounted in series with the first capsule between the latter and a fixed point, which second capsule, if the vehicle is under the control of an authorised person, will contract when the engine is running, so as to nullify the expansion of the first capsule thereby maintaining the closure device in an "open" state.

Contraction of the second capsule may be achieved by connecting it to a source of vacuum such as the inlet manifold of the engine which develops a vacuum when the engine is running. By interrupting such a connection with a normally closed valve (which can only be opened by an authorised user of the vehicle) so the engine exhaust will become blocked as soon as the exhaust gases have heated up the contents of the expansible capsule unless the normally closed valve has been opened to connect the inlet manifold vacuum to the second capsule, as is the case of the engine.
start up procedure is under the control of an authorised person.

The inlet manifold vacuum source may be connected via a one way valve to a vacuum chamber and latter may be connected to the second capsule also by means of a one-way valve so as to obviate vacuum variations during normal running of the engine. In this case, provision is preferably made to vent at least the capsule if not both it and the chamber when the engine is turned off, to allow the second capsule to revert to its usual configuration.

Although in the preferred arrangement as described the interactive means may be pneumatically operable, it is to be understood that the invention is in no way limited to such an arrangement and the interactive means may be operated by any mechanical means, electrical means, electromechanical means, pneumatic means, hydraulic means or any combination thereof.

Likewise although the preferred drive means is described as being a resiliently expansible capsule containing gas or liquid or a combination thereof, the invention is in no way limited to such a drive means and any device whose physical characteristics alter as it is heated, or subjected to pressure, may be employed provided the movement obtained by the rise in temperature, or rise in pressure, is sufficient to activate the closure means.

In an alternative arrangement, where the drive means comprises an expansible gas containing capsule the latter may be connected to the end of a cylinder within which a piston is slideable and which includes spring means which urges the piston towards the said one end of the cylinder.
Preferably the spring means is sufficiently strong so that on its own it resists the increase in pressure within the capsule due to the temperature rise. By connecting the opposite end of the cylinder containing the piston to the inlet manifold of the engine, the combined effect of the vacuum and the increase in pressure in the capsule acting on the other face of the piston is such as to retract the piston from the one end of the cylinder against the action of the spring means so as to increase the volume available to the gas in the capsule, and maintain the pressure therein substantially constant and thereby limit the expansion of the capsule.

Interruption of the vacuum connection whilst the engine is running will immediately cause the piston to move, under the action of the spring, towards the said one end of the cylinder thereby pressurising and expanding the expansible capsule and moving the closure member so as to inhibit the subsequent passage of exhaust gases from the engine.

Authorised use of the vehicle provides a path between the source of vacuum and the capsule so that the spring force is overcome and the capsule does not expand sufficiently to impede the exhaust gases.

Unauthorised use does not allow for the connection of the cylinder to the source of vacuum so that the piston is constantly acted on by the spring and the capsule expansion is not counteracted.

The invention may be used in motor cars powered by petrol or diesel engines and petrol or diesel engined boats.

The invention will now be described by way of example,
with reference to the accompanying drawings, in which:

Figure 1 illustrates diagramatically one embodiment of the invention; and

Figures 2A, B and C illustrate the action of the arrangement shown in Figure 1 under different conditions.

In Figure 1 a pipe 10 is connected at its right hand end to an exhaust manifold (not shown) of an internal combustion engine (not shown) so that exhaust gases can pass in the direction of the arrow through the pipe 10 to enter a silencer system and safely exhaust from the vehicle in known manner.

Blocking the pipe is a flap 12 having an actuating arm 14 extending therefrom into a side housing 15 mounted on the pipe 10. The flap and arm combination 12 and 14 is hinged at 13.

The arm 14 is pivotally attached at 16 to one end of an expansible capsule 18 which contains gas (or more preferably a liquid having a low boiling point), so that with a rise in temperature, the capsule will occupy the position shown in Figure 1 but at normal ambient temperatures the capsule will collapse the bellows or corrugated section so that the flap 12 is pivotted into an upright position to allow for the passage of gases through the pipe.

The manner of operation will be described in more detail in relation to Figure 2.

The capsule 18 is joined to a second similar capsule 20
which is likewise corrugated so as to provide for considerable expansion and contraction. The interior of the capsule 20 is connected via a pipe 22 to a source of vacuum such as to the inlet manifold of the same internal combustion engine as the exhaust pipe is connected, and a normally closed valve 24 controls the flow of gas or liquid to and from the capsule 20.

A control means 26 serves to control the operation of the valve 24 as will hereinafter be described.

The second capsule 20 is not only secured to the left hand end of the capsule 18 but is also secured at its opposite end in a fixed manner to the end 28 of the housing 15. The latter is fixed relative to the pipe 10 and therefore acts as a fixed stop so that the position of the junction 16 and thereby the open or closed state of the flap 12 will be determined by the length of the capsule 20 and the length of the capsule 18 measured from the wall 28. If both capsules are pressurised and thereby expanded into the condition shown in Figure 1, the flap 12 is held firmly in the position shown thereby shutting off the passage of gases through the pipe.

If either or both of the capsules is contracted the flap 12 is automatically raised through approximately 70° so as to open the pipe and allow the passage of gases.

Although not shown stop means may be provided to remove the force exerted on the flap 12 in the event that both of the capsules are contracted, as by providing a stop to restrict the anti-clockwise movement of the arm 14. Alternatively a lost motion connection may be provided or a spring may be used to couple the arm to the flap.
The control 26 may take any convenient form.

In the simplest arrangement a cable or lever mechanism connects the valve 24 to a lever or knob or other device located adjacent the driving position in a car or boat and typically hidden from view and known only to the authorised user of the vehicle.

In more complicated arrangements the control system 26 may be linked with a key switch or a keypad or a radio frequency sensor and decoder for detecting the presence of an appropriate transmitter unit carried only by an authorised user of the vehicle or an infra red sensor or an ultrasonic sensor likewise including decoder means for receiving infra red or ultra-sound signals from appropriate transmitters carried by an authorised user of the vehicle.

Alternatively the unit may comprise a proximity detector tuned to detect the proximity of a passive circuit element similar to anti-theft tags attached to display products in stores which will generate an alarm signal in the event that the product is removed from the store without the security tag having been removed.

Preferably the valve 24 is placed in a most inaccessible position on the motor vehicle and is armoured or otherwise protected so as to render very difficult if not impossible any tampering with the valve so as to enable an unauthorised person to open the valve.

In order to ensure that the capsule 18 collapses to its minimum dimension when it cools down, spring means
designated by reference numeral 30 may be provided for example within the capsule which is extended as the capsule is expanded and which provides a restoring force to collapse the capsule to its normal unextended dimension when the source of heat is removed and the contents of the capsule cool down to ordinary ambient temperatures.

As previously mentioned, preferably an oil or a low boiling point liquid partially fills the capsule 18. By selecting the boiling point appropriately, so conversion of the liquid into a vapour phase can be arranged to occur at a particular elevated temperature only achieved after so many seconds of normal running of the engine so that the flap 12 is kept fully open to enable the engine to be started and if necessary to be driven away a very short distance before there is any tendency for the inhibiting closure to occur.

It is believed that in the case of car or boat theft, it is better for the vehicle to apparently start normally and to be capable of being driven away normally so that the interference with the get away occurs while the vehicle is on the move. In this way the unauthorised person in the vehicle is at a significant disadvantage since as the car or boat rapidly begins to lose power he will be distracted and will possibly be less able to think coherently. The general intent behind the invention is to cause the vehicle to become unusable very shortly after it has been driven away thereby causing the unauthorised person to panic and abandon the vehicle before it has left the marina (in the case of a boat) or the neighbourhood where it has been parked (in the case of a car or lorry) and before it is likely that he can have done any significant damage to the vehicle as might be incurred during a police
chase or the like (in the case of a car) so that the rightful owner can retrieve the vehicle with minimum inconvenience and minimal action by the police.

Figures 2A to 2C indicate the different modes of operation of the device shown in Figure 1.

Figure 2A shows the state of the capsules at start-up when it is assumed that the exhaust system has cooled to ambient temperature. In this situation the capsule 18 will have contracted to its minimum size as shown in Figure 2A but the capsule 20 will possess its normal length since valve 24 is closed and even if pipe 22 is connected to the inlet of the engine and suction appears above valve 24, no suction will be applied to the capsule 20 until the valve 24 is opened.

In this situation the flap 12 will be held firmly in the raised position in line with the flow of gases through the exhaust pipe 10 as shown in Figure 2A.

Although not shown a window surrounds the hinge 13 to enable heat from the hot exhaust gases passing through the pipe 10 after the engine has started to filter into the compartment 15 containing the capsules. Figure 2B shows the result of the heating up process in which the liquid or gases or both within the capsule 18 have caused the latter to expand to its full permitted length thereby rotating the cranked lever assembly 14 and tilting the flap 12 into the position shown in Figure 2B where the flap either completely or at least partially closes off the exhaust pipe. By arranging that the flap moves in the direction shown, the build-up of pressure to the right of the flap as the latter moves downwardly will assist in
closing the flap against the pipe and this process will be cumulative as the flap closes off more and more of the pipe cross section.

Provided valve 24 remains closed, capsule 20 remains elongated and the blocked exhaust pipe rapidly chokes the engine into either a semi-stalled condition in which little or no power can be derived from the engine or into a fully stalled state in which the engine will not operate normally.

The engine will remain in that condition until the capsule 18 has cooled down sufficiently to enable the flap 12 to re-open the exhaust pipe whereupon if the engine is restarted it will again run for a very short time until the capsule 18 is again heated up sufficiently to cause the flap 12 to again block the pipe whereupon the engine will again be choked into a stalled condition.

Clearly such a procedure will inhibit any attempt at driving a boat or car any distance from where it is moored or parked, respectively.

Figure 2C indicates the mode of operation in the event that the vehicle is in the hands of an authorised person. Here the valve 24 will have been opened by the authorised driver so enabling the suction applied to pipe 22 to cause the capsule 20 to contract thereby moving the cranked arm 14 back into the position occupied in Figure 2A and with it the flap 12 into its aligned position enabling gases once again to pass through the pipe 10 from the engine. By ensuring that the valve 24 is opened either before or immediately after the engine has been started it will be seen that the effect of the flap 12 will never be noticed
by an authorised user of the vehicle.

After the vehicle has been used and the engine has been turned off, the control unit 26 is arranged to leave the valve 24 open for long enough for the pressure within the capsule 20 to balance out and enable the capsule once again to expand to its normal state such as shown in Figures 2A and 2B and as the liquid or gases or both in the capsule 18 contract so capsule 18 contracts back to the position shown in Figure 2A so that the flap 12 is retained in its aligned raised position ready for the vehicle to be started normally.

The anti-theft system proposed by the invention is ideally combined with any other system or systems such as those which will draw attention to the vehicle as by sounding an audible alarm to causing lights to flash. Typically the subsidiary alarm system is itself arranged only to operate when the flap 12 begins to close off the exhaust pipe so that both the audible and/or visible alarm suddenly begin to operate at the same time as the engine begins to suddenly lose power and stall. To this end switching means may be located within the housing 15 sensitive to the position of the cranked arm 14 or a time delay may be associated with the ignition switch and an interlock within the control unit 26 such that if the control unit 26 has not been operated to open the valve 24 either at the same time or after the ignition has been turned on, the audible alarm or visual alarm is armed and caused to operate so many seconds after the ignition has been turned on.
CLAIMS

1. Anti-theft apparatus for an internal combustion engine powered a vehicle comprising closure means movable to block or substantially block the engine exhaust path in response to a rise in temperature and/or pressure brought about by the running of the engine and interactive means operable by an authorised user of the vehicle to inhibit or nullify or cancel the blocking movement of the closure means.

2. Apparatus as claimed in claim 1, in which the interactive means is operable from within the vehicle by a button or lever.

3. Apparatus as claimed in claim 2, wherein the button or lever is itself operable only by means of a key or the entry of a code.

4. Apparatus as claimed in claim 1, wherein the interactive means is adapted to be operated automatically when a person carrying a particular coded device enters or boards the vehicle.

5. Apparatus as claimed in claim 1, wherein the interactive means operates automatically if a code is entered by the driver at a particular time during the start-up procedure either before, or after, the engine is started.
6. Apparatus as claimed in any of the preceding claims in which the closure means is located at a point downstream of the exhaust valves of the engine.

7. Apparatus as claimed in claim 6, wherein the closure means is situated in or on the exhaust manifold of the engine.

8. Apparatus as claimed in claim 6, wherein the closure means is situated within a pipe leading from the exhaust manifold to the exhaust and if fitted, silencer system, of the engine.

9. Apparatus as claimed in any of claims 1 to 8, wherein the closure means comprises a pivotable flap which is rotatable by drive means from a position in which the plane of the flap is substantially aligned with the direction of exhaust gas flow (thereby not to impede the flow) to a position in which the flap is substantially perpendicular to the said direction of gas flow to block the flow.

10. Apparatus as claimed in claim 9, wherein the drive means is activated or derives motivating energy from the temperature or pressure rise of gases exhausting from the engine after start-up of the engine, and the interactive means determines a reference position for the said drive means which is movable from a first position (in which movement of the drive means rotates the flap into the said blocking position) into a second position (in which movement of the drive means is either prevented or is ineffective to from rotate the said flap).

11. Apparatus as claimed in claim 9 or 10, wherein the
drive means is responsive to an increase in exhaust gas temperature and comprises a first capsule which is resiliently expansible and contains gas or a liquid or a combination thereof and which is heated by the exhaust gases, and the interactive means comprises a second similar capsule which is resiliently contractible and is mounted in series with the first capsule between the latter and a fixed point, which second capsule can be adapted to contract by an authorised person when the engine is running, so as to nullify the expansion of the first capsule.

12. Apparatus as claimed in claim 11, wherein the adaption of the second capsule is achieved by connecting it to a source of vacuum generated by the running of the engine such as the inlet manifold of the engine.

13. Apparatus as claimed in claim 12, further comprising a normally closed valve in a connection between the source of vacuum and the second capsule, so that the engine exhaust will become blocked as soon as the exhaust gases have heated up the contents of the first capsule unless the normally closed valve has been opened to connect the source of vacuum to the second capsule.

14. Apparatus as claimed in claim 13, wherein the vacuum source is connected via a one-way valve to a vacuum chamber and the chamber is connected to the second capsule also by means of a one-way valve.

15. Apparatus as claimed in claim 14, comprising means to vent at least the second capsule when the engine is turned off, to allow it to revert to its normal uncontracted configuration.
16. Apparatus as claimed in any of claims 1 to 8, wherein the interactive means is operable by mechanical means, electrical means, electromechanical means, pneumatic means, hydraulic means or any combination thereof.

17. Apparatus as claimed in any of claims 11 to 16, in which the drive means comprises an expansible gas-containing capsule and the latter is connected to one end of a cylinder within which a piston is slidable and which includes spring means which urges the piston towards the said one end of the cylinder, and the spring means is selected so as to be sufficiently strong as to resist the increase in pressure within the capsule due to the temperature rise, and the opposite end of the cylinder is connectable to the inlet manifold of the engine whereby the effect of the vacuum and the increase in pressure in the capsule acting on the other face of the piston is such as to retract the piston from the one end of the cylinder against the action of the spring means so as to increase the volume available to the gas within the capsule and maintain the pressure therein substantially constant and thereby limit the expansion of the capsule.

18. Apparatus as claimed in claim 17, wherein interruption of the vacuum connection whilst the engine is running will cause the piston to move under the action of the spring towards the said one end of the cylinder thereby pressurising and expanding the expansible capsule and moving the closure member so as to inhibit the passage of exhaust gases from the engine.

19. Apparatus as claimed in claim 18, wherein authorised use of the vehicle provides a path between the source of
vacuum and the capsule so that the spring force is overcome and the capsule does not expand sufficiently to impede the exhaust gases.

20. Apparatus as claimed in claim 18, wherein unauthorised use will not establish the connection of the cylinder to the source of vacuum so that the piston remains under the action of the spring and the capsule expansion is not counteracted.

21. Apparatus as claimed in any of the preceding claims wherein the vehicle is powered by a diesel engine.

22. Apparatus as claimed in any of claims 1 to 20 wherein the vehicle is powered by a petrol engine.

23. Apparatus as claimed in any of the preceding claims, wherein the vehicle is a motor vehicle.

24. Apparatus as claimed in any of claims 1 to 22 wherein the vehicle is a boat.

25. A vehicle when with an anti theft device as claimed in any of claims 1 to 20.

26. A method of disabling a vehicle comprising the step of blocking the exhaust outlets from the vehicle engine by means of an anti theft device constructed and operated as described and claimed herein.

27. Apparatus as claimed in claim 1, constructed arranged and adapted to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.
INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.C1. 5 F01N7/08; B60R25/04

II. FIELDS SEARCHED

Classification System Classification Symbols

Int.C1. 5 F01N; B60R

III. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>WO A 8 905 251 (MILLAR) 15 June 1989 see page 6, line 34 - page 9, line 29; figures 1-7</td>
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<td>A</td>
<td>WO A 8 807 462 (LAPINSKI) 6 October 1988 see page 7, line 25 - page 8, line 26; figures 1-3</td>
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IV. CERTIFICATION

Date of the Actual Completion of the International Search
29 JANUARY 1993

Date of Mailing of this International Search Report
08.02.93

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