(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 487 445 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **91600010.2**

(51) Int. Cl.^{5} : **A62C 3/07**

(22) Date of filing : **07.10.91**

(30) Priority : **16.10.90 GR 90100756**

(43) Date of publication of application :
27.05.92 Bulletin 92/22

(84) Designated Contracting States :
AT BE CH DE DK ES FR GB IT LI LU NL SE

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(54) Fire detection and automatic and/or manual fire extinguishing system for automotive units.

(57) A system which is designed to be installed in every kind of automotive unit -- and also, with some modifications, in immovable areas -- in order to cover it by fire detection and fire extinguishing in any case of fire outbreak.

The system as a whole consists of two or more subsystems which can operate even independently from one another.

The system can be put into operation :

a. Fully automatically by means of sensors-detectors (D1,D2...) or, in case of a collision, by means of a special adjustable inertia switch (S2).

b. Semi-automatically, by pressing a button (S1,B2).

c. Via remote control (RC2).

d. Fully manually (SM,SV1,SV2).

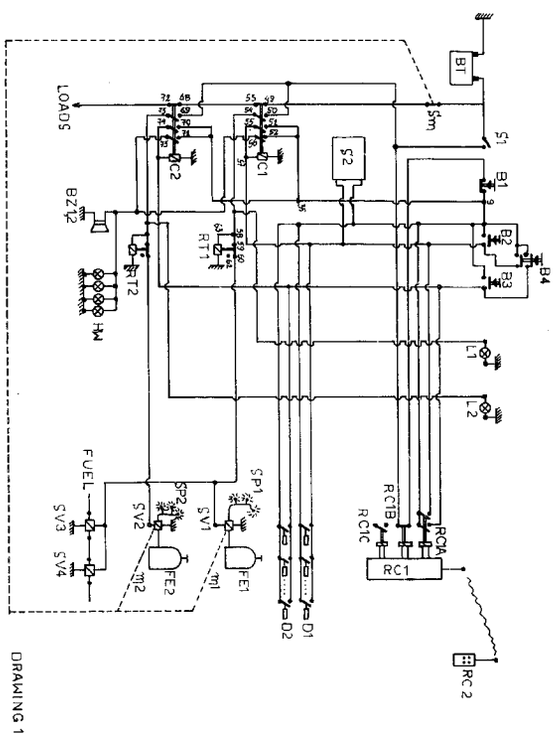
When the whole system or one of its subsystems is put into operation, the following actions are executed simultaneously :

a. Electric power supply to all electrical loads is disconnected.

b. Fuel supply to the engine is shut off (SV3,SV4).

c. The areas covered by the system are sprayed with fire extinguishing liquid.

d. Visual (L1,2) and acoustic (BZ1,2) signals are produced, indicating the system operation.



DRAWING 1

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This concerns a fire detection and fully-automatic or semi-automatic or via-remote-control or manual fire extinguishing system which is designed for installation in every automotive unit (cars, buses, sea vessels, etc.) and also, with minor modifications, in immovable areas.

Systems of such kind are used today in racing cars but they are put in operation only manually and are designed in such a way that: on the one hand, (due to a low weight requirement) they do not weigh much, thus their capabilities are significantly limited; on the other hand, they cover just by fire extinguishing (fire detection not inclusive) only the very "hazardous" points of the car. A result of the above is that these systems do not provide coverage in all cases and they are not reliable. Moreover, they apply only to racing cars which in any case are built in such a way that they do not ignite easily (they employ safety fuel tank, they do not contain carpets and other inflammable materials, etc.).

These systems could not be installed in any vehicle without major and most significant modifications, additions and extensions in their size and their way of operation.

Some systems also perform fire detection by means of the well-known system of the bulb which breaks -- thus releasing fire extinguishing liquid -- when the temperature rises above the breakage point of the bulb. However, this system cannot operate reliably in the engine compartment of the cars due to the existing high temperatures during normal engine operation.

The proposed system is advantageous, compared with the existing systems, on the following points:

1. Applies to every automotive unit (and, with some modification, applies also to immovable areas).
2. Covers the area in which it is installed by fire detection and fire extinguishing.
3. It is put into operation fully automatically, or semi-automatically or via remote control or completely manually.
4. The system is put into operation automatically in case of a collision, activated by a special adjustable inertia switch.
5. If the system is put into operation by any means, the following actions are executed simultaneously:
   a. Electric power supply to all electrical loads of the vehicle is disconnected.
   b. Fuel supply to the engine is discontinued and shut off by means of fuel supply shut-off electric solenoid valves.
   c. The areas are sprayed with fire extinguishing liquid, either preventively or suppressively.
   d. Visual and acoustic signals are produced, indicating that the system has been activated.

The capabilities and the operation of the system are as follows:

1. It detects the fire which has broken out at the hazardous points of the vehicle (carburetor, fuel pump, fuel tank, instrument panels, wiring, etc.).
2. Isolates the electric circuits of the vehicle by disconnecting the electric power source (battery).
3. Discontinues and shuts off the fuel supply.
4. Sprays with fire extinguishing liquid (Hallon or some other better one, depending on the area covered) the hazardous points or even additional points.
5. Informs the owner directly or via remote control, visually and acoustically, when the system is put into operation.

The abovementioned actions can be executed in the following ways:

1. Automatically, when a command is given by the system sensors-detectors or by the adjustable inertia switch which activates the system automatically in case of a collision.
2. Semi-automatically, when the system is activated by pressing one or two buttons which are placed at an ergonomic location near the instrument panel or when the activation is effected by the remote control which is incorporated into the system.
3. Manually, when the system is activated completely mechanically by pulling a cable.

The whole system consists of two subsystems:

1. Subsystem 1, fire detection and fire extinguishing of the engine compartment.
2. Subsystem 2, fire detection and fire extinguishing of the instrument panel wiring.

The system is shown on drawing 1 and consists of the following parts:

BT	: Battery
S1	: System main switch
B1	: Stop button
B2	: Button activating subsystem 1
B3	: Button activating subsystem 2
B4	: Double-action button which activates the whole system (both subsystems simultaneously)
L1	: Indicating lamp for subsystem 1 operation
L2	: Indicating lamp for subsystem 2 operation
RC1	: Remote control

RC2 : Telecommander with buzzer and indicating lamp
S2 : Adjustable inertia switch which activates subsystem 1 in case of a collision
D1 : Sensors-detectors of subsystem 1
D2 : Sensors-detectors of subsystem 2
C1 : Contactor of subsystem 1
C2 : Contactor of subsystem 2
RT1 : Timing relay for de-activating subsystem 1
RT2 : Timing relay for de-activating subsystem 2
FE1 : Fire extinguishing liquid container for subsystem 1
FE2 : Fire extinguishing liquid container for subsystem 2
SV1 : Electric solenoid valve releasing the fire extinguishing liquid for subsystem 1
SV2 : Electric solenoid valve releasing the fire extinguishing liquid for subsystem 2
SP1 : Sprinklers for subsystem 1
SP2 : Sprinklers for subsystem 2
SV3 : Electric solenoid valve for shutting off fuel supply, installed near the fuel pump
SV4 : Electric solenoid valve for shutting off fuel supply, installed right after the fuel tank
Sm : Manually-operated switch for isolating the battery
m1 : Manually-operated sprinkling of fire extinguishing liquid for subsystem 1
m2 : Manually-operated sprinkling of fire extinguishing liquid for subsystem 2
BZ1,2 : Buzzer for subsystems 1 and 2
HW : Hazard warning system of the vehicle (all four side repeater lamps flashing together)

The operation of the system shown on drawing 1 is as follows:

* The battery BT supplies the whole system with the required electrical energy.
* Main switch S1 isolates the system from the battery BT, thus putting it out of operation when deemed necessary.
* Button B1 (stop) is connected in series with contact RC1B of remote control RC1.
* Button B2, sensors-detectors D1 of subsystem 1, adjustable inertia switch S2 (which activates subsystem 1 in case of a collision), button B4 and contact RC1A of remote control RC1 are all connected in parallel.
* Button B3, sensors-detectors D2 of subsystem 2, button B4 and contact RC1A of remote control RC1 are also connected in parallel.

Operation of subsystem 1:

When the main switch S1 is closed, it permits the system to operate. If the vehicle's driver presses button B2, or if the sensors-detectors D1 detect smoke or fire in the engine compartment, or if in case of a collision the contacts of the adjustable inertia switch S2 close, then contactor C1 is energized and remains energized by means of the self-holding connections 9, 35, 51, 55, 57, thus activating subsystem 1 of fire extinguishing in the engine compartment. When C1 is energized, contacts 50-54, 51-55, 52-56 close and contact 49-53 opens. Through the closed contact 50-54, electric solenoid valve SV1 is energized and opens, thus releasing the flow of fire extinguishing liquid from the container FE1 to the sprinklers SP1, which sprinkle/spread the liquid in the engine compartment, thus extinguishing the fire which broke out there. From the same contact 50-54, electric solenoid valves SV3, SV4 are energized and they shut off the fuel supply, thus eliminating the possibility of the fire spreading due to fuel leakage. Simultaneously with the above actions, the opening of contact 49-53 of contactor C1 disconnects the power supply to all loads of the vehicle. This is done because there is a possibility that the cause of fire may be a short-circuit. By disconnecting the power supply, the cause which brought about the fire ceases to exist. When subsystem 1 is activated, indicating lamp L1 lights and at the same time the buzzer BZ1,2, the hazard warning (the four flashing side repeater lamps of the vehicle), the buzzer and the indicating lamp of the telecommander are also put into operation. In this way, the vehicle's driver is informed that the system has started operating.

In the wiring from contact 54 to the solenoid valves SV1, SV3, SV4, as shown, timing relay RT1 is interposed. The coil of RT1 (contact 63) is energized as soon as the contact 50-54 of contactor C1 closes. From the moment that contact 63 is under tension, RT1 holds the contact 59-60 closed, for as much time as it has been set. When this time elapses, RT1 "cuts off" opening the contact 59-60 and disconnecting the power supply to SV1, SV3, SV4. The setting time for RT1 should be equal to or greater than the time which is required for emptying the container FE1.

Operation of subsystem 2:

If the driver presses the button B3, or if the sensors-detectors D2 detect smoke or fire in the wiring compartment of the instrument panel, then contactor C2 is energized and remains energized in the same manner as C1. Thus subsystem 2 is activated. When C2 is energized, contacts 69-73, 70-74 and 71-75 close and at the same time contact 68-72 opens. Through the closed contact 69-73, electric solenoid valve SV2 is energized, thus permitting the flow of fire extinguishing liquid from the container FE2 to the sprinklers SP2, which spread/sprinkle the liquid in the wiring compartment of the instrument panel, and extinguishing the fire in this area. Simultaneously with the above actions, the opening of contact 68-72 disconnects the power supply to all loads for the same reasons mentioned above in the preceding paragraph. When subsystem 2 is activated, indicating lamp L2 lights and at the same time the buzzer BZ1,2, the hazard warning, the buzzer and the indicating lamp of the telecommander are put into operation, in order to inform the driver in the case of automatic activation of the subsystem. The timing relay RT2 operates exactly like RT1 mentioned above. The time for RT2 should be set to be equal to or greater than the time which is required for emptying the container FE2.

Operation of the system as a whole (both subsystems 1 & 2 simultaneously:

As it is also shown on drawing 1, the double-action button B4 and the contacts RC1A of the remote control RC1 are connected together in parallel and also in parallel with each one of the buttons B2 and B3. This means that when B4 is pressed, or when the contacts RC1A close via the remote control, then subsystems 1 and 2 are simultaneously activated and each one operates in the way that it has been described above.

Manual operation:

The plungers of the electric solenoid valves SV1 and SV2 and the switch Sm are mechanically connected together by means of a cable. Pulling of the cable's end, which will be installed at an ergonomic location close to the driver, causes the opening of the plungers of SV1 and SV2 and at the same time the opening of the switch Sm. Thus the flow of the fire extinguishing liquid found in the containers FE1 and FE2 is released to the sprinklers SP1 and SP2 of subsystems 1 and 2 respectively, and at the same time the power supply to all loads of the vehicle is disconnected. A provision was made for the abovementioned manual operation for the case that some unforeseen intervention on the system might be effected. By the manual operation, the system is activated completely mechanically, not requiring electric power.

De-activation of the system:

The whole system or each one of the two subsystems 1 and 2 are de-activated and cease to operate upon pressing the button B1, or via the remote control by opening of the contact RC1B, or by opening the system main switch S1, or by disconnecting one of the two poles of the battery.

As it has appeared from the description above, the system operation requires the manufacture of an adjustable inertia switch which will activate the system in case of a collision and which is a distinctive component of the system.

The adjustable inertia switch is shown on drawing 2 and consists of: the chassis (1), the sliding mass (2), the linear motion ball bearing (3), the guiding rods (4), the return sptrings (5), the spring tension regulators (6), the jam nuts (7), the contact points (8), the contact point metal strips (9), the cables (10), the terminal lugs (11) and the cover (12).

The operation of the adjustable inertia switch shown on drawing 2 is as follows:

The switch chassis is fixed by screws on the vehicle's frame. Thus every change in the kinetic condition of the vehicle is transferred identical to the switch chassis (1), while the sliding mass (2) performs due to inertia some additional movement in the direction of the guiding rods (4). In the case of a vehicle collision, we have a very abrupt change in the vehicle's kinetic condition (very high deceleration). If the deceleration is larger than the one for which the return springs (5) have been adjusted, then the contacts points (8b) of the sliding mass (2) will touch on the contact points (8a) and, through the sliding mass body (2) and the cables (10), the circuit which is connected at the terminal lugs (11) will close, that is, subsystem 1 of the fire extinguishing system will be activated.

In case that we would like to have activation of subsystem 1 additionally in the case of a vehicle side collision, it is sufficient to install one more adjustable inertia switch transversely on the vehicle's frame.

Due to the fact that the change in the vehicle's kinetic condition depends directly also on its mass, and because each type of vehicle has a different mass, the return springs' (5) tension will have to be adjusted depending on the type of the vehicle, so that undesirable actuations will be prevented.

For its manufacture, the system as a whole requires the assembly and electrical connection of existing-

technology components (contactors, buttons, timing relays, remote control, buzzer, electric solenoid valves, switches, indicating lamps, smoke or fire sensors-detectors, etc.), and the manufacture, assembly and electrical connection of the adjustable inertia switch components. The parts which comprise the adjustable inertia switch are manufactured from hard metal (or other durable materials) in order to withstand the strain of a collision, and they can be processed easily by machine tools.

It is important to note the following for the system as a whole:

1. All wiring of the system is electrically and thermally insulated with incombustible coating, so that the breaking out of a fire will not result to its destruction and thus to the system's non-operation.
2. All piping included in the system is made of fire-resistant material.
3. The system components (contactors, electric solenoid valves, timing relays, etc.) are installed and covered in such a way and with such kind of materials, so that they do not run the risk of getting destroyed by fire.
4. The system as a whole may be manufactured in such a way that it consists of more than two subsystems. If, for example, the purchaser of the system wants to additionally cover by fire detection and fire extinguishing the passenger compartment, then one more complete subsystem with all its components (contactor, sensors-detectors, buttons, indicating lamps, timing relays, electric solenoid valves, sprinklers, etc.) may be added, or more sensors-detectors and sprinklers, properly connected, may be added to one of the existing subsystems in the area to be covered.
5. As it is shown on drawing 1, the remote control RC1 is equipped with one extra contact RC1C which is not needed in the system. This contact has been provided for the possibility that the purchaser of the system may wish to assign to the contact the activation command of an alarm system sold in the market. In this way the purchaser does not need to carry with two telecommanders. Of course, if some purchaser has already installed an alarm system, then a remote control can be chosen which will be able to operate with both the existing alarm system and the system to be installed.
6. Each type of automotive unit constitutes a separate case of the system's study and design. Before the system is installed in some kind of automotive unit, it should be studied and designed from the beginning, taking into account the specific dimensions available space. Furthermore, the best system components should be chosen for the specific type of automotive unit.

Claims

1. Fire detection and fully-automatic or semi-automatic or via-remote-control or manual fire extinguishing system for every automotive unit.

The system contains (drawing 1): switches, buttons, indicating lamps, remote control, telecommander with buzzer and indicating lamp, contactors, timing relays, buzzer, sensors-detectors, fire extinguishing liquid containers, electric solenoid valves for releasing the fire extinguishing liquid, fire extinguishing liquid sprinklers, electric solenoid valves for shutting off fuel supply, electrically and thermally insulated wiring with incombustible coating, piping made of fire-resistant material.

The system is characterized from the fact that the assembly of the parts which it consists of is such that the system is separated into two subsystems: one for fire detection and fire extinguishing in the engine compartment and one for the fire detection and fire extinguishing in the wiring compartment of the instrument panel.

Another feature of the system assembly is the fact that, no matter which way is the system put into operation (automatically, semi-automatically, via remote control or manually), the system: interrupts the power supply to all electrical loads, shuts off fuel supply to the engine, sprinkles fire extinguishing liquid to all points covered, and informs of its operation by producing acoustic and visual signals.

2. Fire detection and fully-automatic or semi-automatic or via-remote-control or manual fire extinguishing system for every automotive unit, in accordance with claim 1, which is additionally characterized by the fact that it can be put into operation automatically in case of a collision, activated by a special adjustable inertia switch.

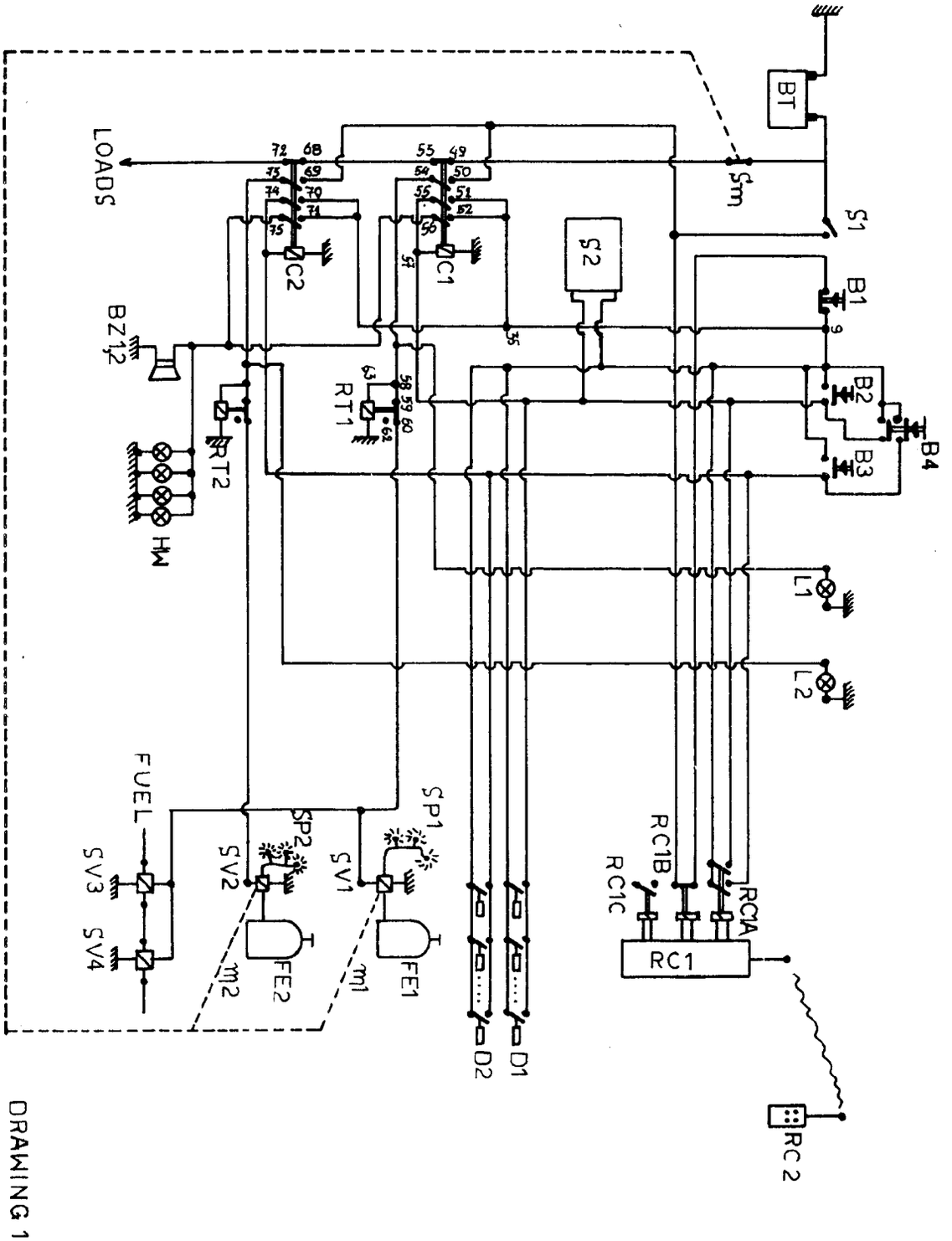
The adjustable inertia switch consists of (drawing 2): the chassis (1), the sliding mass (2), the linear motion ball bearings (3), the guiding rods (4), the return springs (5), the return springs' tension regulators (6), the jam nuts (7), the contact points (8a, 8b), the contact point metal strips (9), the cables (10), the terminal lugs (11), the cover (12). It is manufactured from hard metals or other durable materials in order to withstand the strain.

A feature of the adjustable inertia switch's operation is that the switch closes the circuit which is

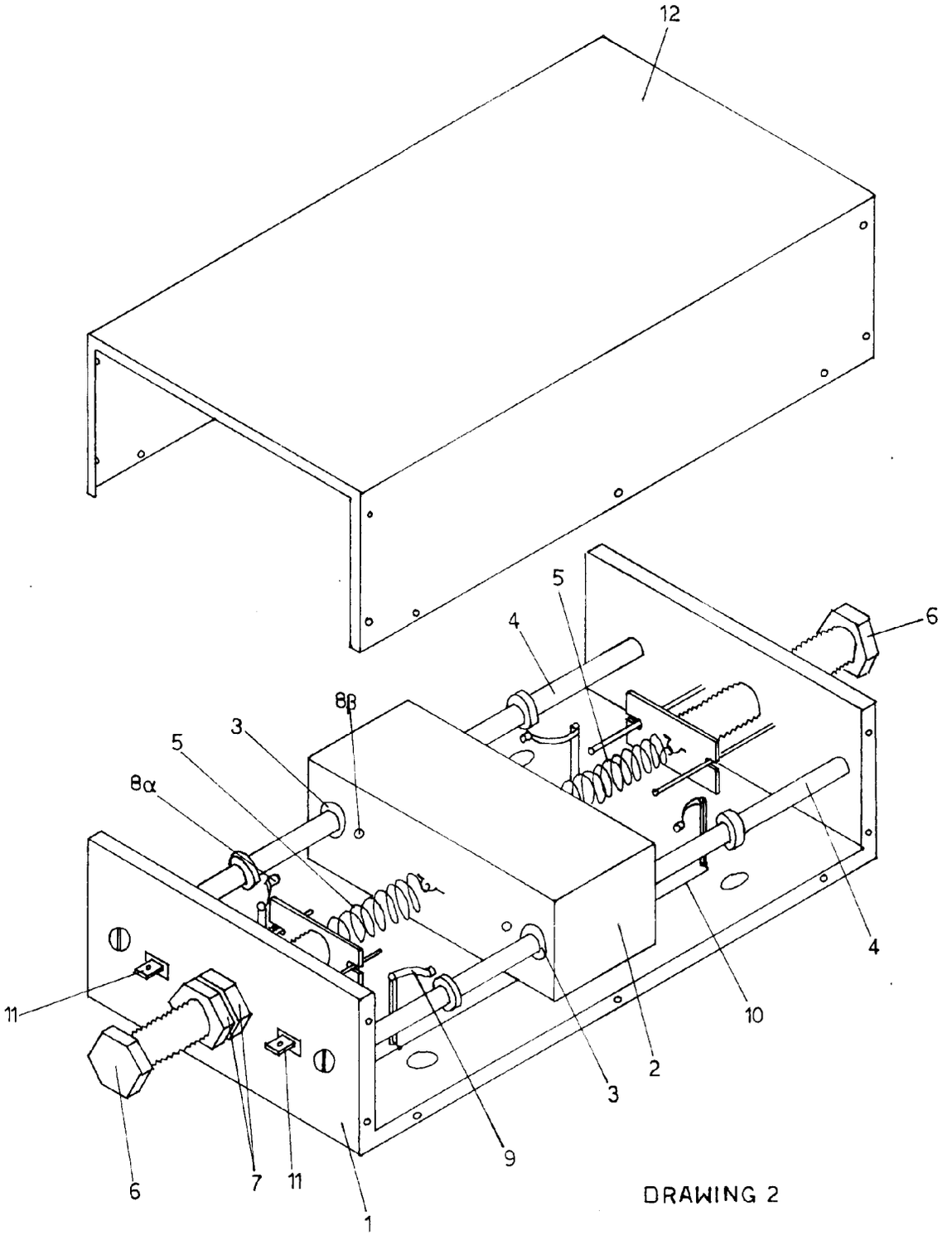
connected to its terminal lugs (11) when its kinetic condition changes abruptly and by a large amount, in the direction in which the sliding mass (2) is capable of moving.

3. Fire detection and fully-automatic or semi-automatic or via-remote-control or manual fire extinguishing system for every automotive unit, in accordance with claims 1 and 2, which consists of more than two subsystems for covering additional areas by fire detection and fire extinguishing.

4. Fire detection and fully-automatic or semi-automatic or via-remote-control or manual fire extinguishing system designed to cover immovable areas by fire detection and fire extinguishing.


BT
LOADS
Sm
S1
S2
B1
B2
B3
B4
BZ1
RT1
RT2
HW
L1
L2
C1
C2
FUEL
SV1
SV2
SV3
SV4
SP1
SP2
FE1
FE2
m1
m2
RC1
RC1A
RC1B
RC1C
RC2
D1
D2

DRAWING 1



DRAWING 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 60 0010

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A- 752 560 (SPECIALTIES DEVELOPMENT CORP.) * Page 1, lines 17-56; page 2, line 13 - page 3, line 78; figure 1; page 4, lines 28-68 *	1,3	A 62 C 3/07
A	EP-A-0 036 071 (CATERPILLAR TRACTOR) * Page 3, lines 17-29; page 4, lines 19-30; pages 5-9; figure *	1	
A	US-A-2 338 440 (KOCHMANN) * Page 1, left-hand column, line 31 - right-hand column line 44; page 2, right-hand column, line 38 - page 3, left-hand column, line 7, figure 1; page 3, right-hand column, lines 16-49, figures 4-6 *	2	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 62 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07-02-1992	KAPOULAS T.

CATEGORY OF CITED DOCUMENTS

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