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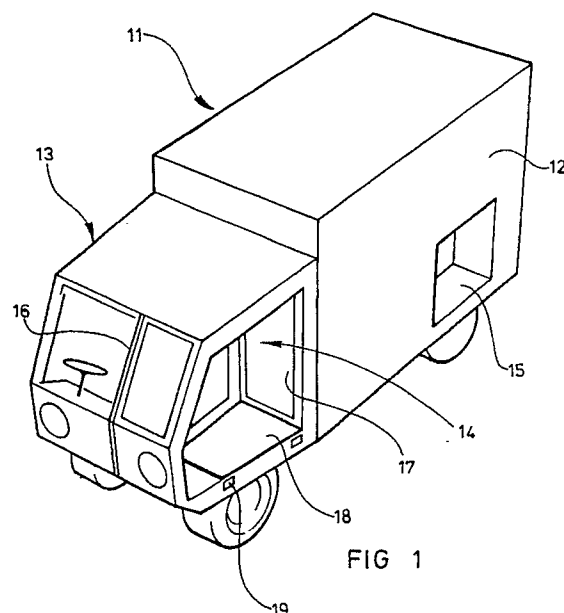
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(54) **A load security system.**

(57) A security system for ensuring that a platform (18) is correctly loaded, comprising weight sensors (19, 20, 21, 22) sensitive to the laden weight of the platform (18) when preliminarily check loaded, storage means (38, 39) for storing a value corresponding to the correct load, a comparator 33 connected to the said weight sensors (19, 20, 21, 22) and to the said storage means (38, 39) and operative, when energised, to provide an alarm signal if the weight sensed upon energisation does not lie within a pre-determined range of the said preliminary check loading thereof.



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A LOAD SECURITY SYSTEM

The present invention relates generally to security systems, and in particular to a load security system.

Security for items susceptible of theft often relies on means for detecting the theft which, although operating at the time, do not provide an immediate alarm indication. For example visual scanning means such as closed circuit television can provide a detection of the theft, but only if they are constantly monitored will they provide an immediate detection. However, in practice it is usually impossible to commit sufficient attention to such visual scanning means to maintain a constant monitoring, and the television signal is therefore usually recorded. To save tape the recording may be intermittent, or alternatively may be wiped clean and reused wherever the recording reaches the end of the tape. This results in potential loss of information and certainly means that close attention to the recording is only given after a theft has taken place. The emphasis on such systems is thus the subsequent detection and capture of criminals rather than the prevention of crime. Immediate detection of a theft or attempted theft, however, not only has the beneficial effect of preventing that theft from taking place, but also has a more general deterrent effect on would be thieves who, in the knowledge that constant monitoring is being effected, will not attempt a crime. Shoplifting, for example, is greatly reduced by the installation of electromagnetic tags and induction loop sensors at the doorways to the premises. There are circumstances, however, where such detection means are inappropriate, for example when the valuables subject to theft are too small to be tagged, for example jewellery, or where other circumstances prevent such techniques, for example when transferring bank notes or other valuables by vehicle from a bank or retail premises.

Security is achieved in the latter situation by the use of secure vehicles, for which purpose a number of specialist carriers have developed techniques and equipment for maintaining security in such transactions. Known secure vehicles have three isolated compartments, namely an armoured vault at the rear of the vehicle, the driver's compartment, which is locked, and an operator or passenger compartment usually at the front of the vehicle to one side of the driver's compartment. The routine for transferring bank notes or other valuables to the vehicle, then, involves the driver remaining in position in the locked driver's cab to which would-be thieves cannot gain access except by damaging the vehicle. The vault operator, who is locked in the vault, is provided with a secure

hatch having a door at each end with a mechanism which allows only one to be open at a time, and the operator or passenger leaves the vehicle to carry the valuables from the premises to the hatch and then, having successfully transferred the valuables into the vault rejoins the vehicle by re-entering the part of the cab allocated for his transport and the vehicle continues on its round or journey.

It has been found recently that although the driver and the vault operator are relatively secure against the actions of criminals, the transfer operator (or operators since there may be, in some circumstances, more than one of them) is relatively less secure because he has to leave the vehicle and enter the premises from which the valuables are being transferred. It is usual to break down a valuable load into smaller units which are individually transferred from the secure location in the premises to the vault so that the transfer operator is at no time carrying a bag or other container of sufficient value to warrant direct attack on him whilst effecting the transfer. The accumulated contents of the security vehicle may nevertheless become vulnerable to attack if the vehicle can be transported to a suitable concealed location. Although it is not possible to gain access to the driver's cab to steal the vehicle, attempts have been made to hijack security vehicles by criminals entering the transfer operator's compartment and threatening the life of the operator thus forcing the driver to comply with the criminal's wishes and to drive the vehicle to a preselected spot where mechanical equipment for ripping open the secure vault may have been preliminarily positioned.

This, of course, relies on the driver's cooperation and it is proposed here to solve this problem by physically preventing the driver from driving the vehicle, and sounding an alarm if it is put in motion with anything other than the known weight of the transfer operator or crew in the operator's compartment. Thus, if a criminal enters the operator's compartment and threatens the operator the security system will automatically disable the vehicle. Likewise, if the criminal enters instead of the operator the system will also detect that the weight is incorrect and still disable the vehicle. In order for this to be successful it is necessary to be able to update a weight sensor within the operator's compartment to determine, from time to time, the correct weight of the operator so that the vehicle can neither be driven without the correct operator in position or with more than the correct operator in position. Furthermore, it is necessary to limit the updating opportunities, typically to only one per day, in order to ensure that the apparatus can be

set only when an authorised setting operation is being performed.

The same concepts can be applied to detecting the weight of, for example, the load on a lorry in transit, or the load applied by the jewellery in a jewellery tray, so that should any attempt be made to steal any of the contents of the lorry or of the jewellery tray an immediate alarm indication is given at the time. In the context of a goods vehicle, therefore, the load platform may be provided with appropriate sensors capable of providing an alarm indication as soon as the vehicle is unloaded by a predetermined amount, suitable hysteresis being included in the system to prevent short term weight fluctuations, such as would be due to irregularities in the road during motion, from triggering the alarm system.

In the context of a jeweller's tray or other such carrier of valuable items, it is envisaged that the weight sensor will be energised by a suitable switch which may be directly or remotely operated, for example by means of radio waves or other transmissions the proximity of a source of which indicates the proximity of an authorised person. Thus, for example, an unobtrusive monitoring system can be put into operation by utilising a weight sensor which will immediately produce an alarm indication if the weight on a jewellery tray changes by an amount sufficient to imply removal or attempted removal of even one of the items from the tray, which would be inhibited by the signals transmitted from a device carried by an authorised person. The normal business transaction in a jeweller's shop, therefore, involving the authorised person lifting down a tray from a shelf, displaying the wares, even by removing them from the tray for consideration by a prospective customer, would not cause an alarm indication to be given since, although the alarm would be triggered by the weight change, the alarm indicator would be inhibited by the transmissions radiated from the equipment on the authorised person. Should a weight change take place whilst the authorised person has moved away from the tray, for example to deal with another customer, or to select another tray (a typical ploy utilised by thieves is to divert the assistant's attention, for example by requesting to see further items on a remote tray, and then removing jewellery items from the tray on the counter whilst the assistant's back is turned) this would immediately result in an alarm indication alerting the assistant to the fact that an item of jewellery had been removed from the tray. If the customer were merely examining the goods there would be no problem, merely a small embarrassment, and the assistant would be able to keep a mental check on the number of items which had been removed from the tray. On the other hand an intending thief would be imme-

diately detected.

According to one aspect of the present invention, therefore, a security system for ensuring that a platform is correctly loaded, comprises weight sensor means sensitive to the laden weight of the platform when a preliminary check load is placed on it, storage means for storing a value corresponding to the correct load, and comparison means connected to the said weight sensor means and to the said storage means and operative, when energised, to provide an alarm signal if the weight sensed upon energisation does not lie within a predetermined range of the said preliminary check loading thereof.

The check loading can be easily achieved by means of an "update" switch operated by a key available only to authorised personnel so that the correct weight on a platform can be changed from time to time.

In the context of a vehicle security system having a loadable platform such as the platform for goods or a platform for an assistant operator in a security van, the present invention provides means for ensuring that the vehicle is not driven without the correct load, comprising means sensitive to the applied load on the platform operative to produce a signal representative thereof, means for storing data representing the correct load on the platform, means for comparing signals representing the instantaneous load on the platform and the stored load signal, and an alarm system triggered by a sensor which detects if the vehicle is put in motion when the output from the comparison means represents substantial inequality in the two compared signals.

In this latter context, attempts to put the vehicle in motion can be considered to correspond to the absence of the authorised person in the above example of a jeweller's tray system.

In a preferred embodiment of the invention the vehicle security system is further provided with means for resetting the said storage means to a new authorised load weight. Such re-setting means preferably has an associated timer inhibiting its operation for a predetermined time interval after each operation. Such time interval may, for example, be in the region of twenty-four hours so that each security van can be set to the weight of its operator or operators at the beginning of the day, and this weight reading will remain in effect for the whole of the working day until the van returns. In such a system the van can be driven only when the correct operator is in place. Should the operator not return to the van it cannot be driven without triggering the alarm and should another person enter the operator's position either in place of the correct operator or in addition to the correct operator, the alarm system will again be triggered

as soon as an attempt is made to drive the vehicle.

Preferably there are provided authorised timer override means to allow the resetting means to be operating within the said predetermined time interval. This is necessary, for example, to accommodate unexpected, but not criminal, eventualities such as the operator being taken sick or otherwise being unable to continue with a days work during the middle of the day, which eventuality would otherwise disable the van for the rest of the day. Again it is envisaged that the override means would involve the use of keys available only to authorised personnel.

The said resetting means may include means for generating a digital control signal and a memory for storing the digital control signal between successive resetting operations thereof. The said means for generating a digital control signal may comprise a counter supplied with a digital signal from a clock, means for providing a digital weight signal representing the load on the platform during the resetting operation, comparator means for comparing the digital weight signal with the digital output signal from the counter, and means for inhibiting the clock when coincidence of the two signal values is detected.

The said counter also preferably serves as the said storage means, providing a digital output signal representing the digital value counted at the time coincidence was detected with the platform load upon setting.

The output signal from the counter is, in a preferred embodiment, supplied to a further comparator which also receives a signal representing the instantaneous load on the platform.

There are also preferably provided alarm inhibit means preventing operation of the alarm unless the vehicle is put in motion. This allows the passenger or operator to leave the vehicle and return to it when stationary without triggering the alarm, but results in an alarm indication occurring if the vehicle is driven off before the operator returns to load the platform appropriately with his own weight.

The alarm indication means also preferably includes means for inhibiting the operation of the vehicle, such as an engine cut out mechanism, preventing the vehicle from being moved whilst the alarm condition persists.

The alarm inhibit means conveniently comprises a switch linked to the vehicle clutched pedal so that the alarm is armed as soon as the clutch pedal is depressed. Although armed the alarm signal would not be triggered unless there is a suitable load differential between the memorised and the instantaneous load on the platform. Furthermore, a suitable time delay before the alarm indication is given after triggering thereof is preferably built into the system so that it is clear to those

who may have caused the alarm that the situation is entirely out of the control of the operator. This is intended to prevent spontaneous reprisals on the van operating staff which are both unjustified and ineffective.

Of course, there are needed means for adjusting the load differential at which alarm triggering takes place to account for different situations since there may be situations in which a relatively large load differential can be tolerated without being an indication of an alarm situation. Means may also be provided to set more than one authorised weight in the memory, for example to allow different combinations of personnel to be carried.

One embodiment of the present invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a part of a security van illustrating the provision of an operator-sensing load platform;

Figure 2 is a simplified schematic circuit diagram illustrating the essential components of the device of the invention; and

Figure 3 is a circuit diagram of a system suitable for incorporation in a security vehicle.

Referring first to Figure 1, a security vehicle is generally indicated with the reference numeral 11, and is separated, in a known way, into a secure vault 12 comprising the main load-carrying compartment of the vehicle, a driver's compartment 13 and a passenger or operator's compartment 14. The vault 12 is armour-plated and provided with a twin door hatch 15 of the "air lock" type having doors at each end interlinked in such a way that only one can be open at any one time. The driver's compartment 13 is in communication with the vault 12 by radio, but otherwise the vault 12 is locked and has no communication with the outside world. The operator's compartment 14 is separated from the driver's compartment by a dividing wall 16 and the operator has a door 17 by means of which he can enter and leave the vehicle unobstructed. The floor of the operator's compartment 14 is provided with a load platform 18 mounted on four strain gauge sensors 19, 20, 21, 22 closing spaced to the floor and connected to a sensing circuit the details of which are described in relation to Figure 2. The output from the sensing circuit leads to a vehicle ignition cut off switch (not shown) and to an alarm siren or other audible warning device (again not shown) both of which are protected by armour plating to prevent interference with the alarm indication and vehicle disablement which takes place when an alarm event is detected.

Referring now to Figure 2, the basic principles of the invention, which allow a new weight on the load platform to be memorised for each given

working period, comprises the four strain gauge sensors 19, 20, 21, 22 which, as can be seen from the inset in Figure 2, are formed each as two metal film sensors identified with the reference numerals A and B on opposite sides of a flexible beam 23 and connected in a bridge configuration which is adjustable by means of the variable resistor 24. A differential amplifier 25 is connected across the bridge circuit with its non-inverting input being connected via an integrator comprising a resistor 26 and capacitor 27 to the tapping of the variable resistor 24, and the inverting input being fed via a variable resistor 28 which acts to set the weight range which is to be detected by the device. The integrator comprising the resistor 26 and capacitor 27 introduces a degree of hysteresis in the operation of the differential amplifier 25 so that transient loads such as by the operator jumping onto the platform when returning to the vehicle will not cause triggering. The output from the differential amplifier 25 is further integrated via a resistor 29 and capacitor 30 before being supplied to the non-inverting input of a buffer amplifier 31 the output of which is fed back to the inverting input and connected via an adjustable resistor 32 to the non-inverting input of a further differential amplifier 33 which acts as a comparator in a manner which will be described hereinbelow and to the inverting and non-inverting inputs of two further differential amplifiers 34, 35 (the latter via an adjustable resistor 36 for reasons which will be described in more detail below) which act as discriminators. The initial load setting operation is performed by a circuit comprising a differential amplifier 37 the output from which is supplied to the inverting and non-inverting inputs of the discriminator amplifiers 34, 35 respectively, and to the inverting input of the comparator 33, a digital-to-analogue converter 38, a digital counter 39, and a clock oscillator 43 the output from which is fed to the counter 39 and which is controlled by a clock stop signal on a line 44 supplied from the output of the comparator 33. A reset control 41 is provided, which when triggered starts the counter 39 so as to count pulses generated by the clock 43. The output from the counter 39 is supplied to the digital-to-analogue converter 38 which, energised by the reference voltage source 40 provides a varying analogue output signal to the differential amplifier 37 the output from which feeds the comparator 33 and discriminators 34 and 35. The comparator 33 also receives an input voltage via the adjustable resistor 32 the analogue value of which varies in dependence on the loading on the platform which affects balance of the bridge circuit comprising the strain gauges 19-22. As can be seen in the inset to Figure 2 the strain gauges are placed one above and one below a flexible beam and electrically

connected in opposite limbs of the bridge circuit so that, as can be seen by the reference numerals, the upper strain gauge 19a is in one limb whilst the lower strain gauge 19b of the same pair is in the opposite limb whereby to maximise the unbalancing effect of a compressive force on one strain gauge, which is matched by a tensile force of equal and opposite magnitude on the other strain gauge. The clock 43 is stopped when the inputs to the comparator 33 bear a predetermined relationship to one another so that the counter 39 contains a count representing the value of the load applied to the platform at the time the setting operation is performed. This then determines the analogue value of the output signal from the amplifier 37, which is supplied to the discriminators 34, 35 which respectively detect whether the output signal from the buffer amplifier 31 is greater than or less than the value of its output at the setting operation. The outputs of the discriminators 34, 35 are supplied via diodes 45, 46 fed to a Schmidt trigger 47 which is triggered when the output from either the discriminator 34 or that from 35 exceeds a predetermined value. The output from the Schmidt trigger 47 is fed on a line 48 as the alarm triggering signal to appropriate audible alarm circuits and/or to vehicle disabling means.

The discriminators 34, 35 are driven by a constant current source 49 the configuration of which is not illustrated in detail in Figure 2. The load-setting operation can only be performed by resetting the counter 39 by means of the reset control 41, which latter may be provided with restricted access means, lock and key, secret access codes and the like, to ensure that this task can only be performed by authorised personnel, or as shown in Figure 2, may be operated remotely via a radio control unit 42.

In the modified embodiment of Figure 3 those components which fulfil the same or a similar function have been identified with the same reference numerals. In addition, however, the circuit of Figure 3 includes light emitting diodes 50, 51 the former connected to a 10 volt power supply and operating to provide a green light output when the alarm is not triggered, and the latter emitting red light when the output from the Schmidt trigger 47 goes high, to provide an alarm indication. The alarm output is not armed, however, unless a clutch switch 52 is closed to discharge a capacitor 53 and initiate charging of a capacitor 54 which causes a Schmidt trigger 55 to fire (when the voltage has risen high enough) thereby causing transistor 56 to conduct disabling the ignition circuit which is connected to terminal 57. This circuit operates in a slightly different manner to determine the correct weight on the load platform. As in the circuit of Figure 2, at the commencement of a working day the operator

or operators who are to be carried in the operator compartment of the vehicle stand on the platform to cause the strain gauge bridge circuit to generate, through the amplifier 25, and the buffer 31, an input to the comparator 33. With the operators thus in position, a reset button 57 is depressed causing a trigger 58 to go low, re-setting the alarm circuit (if it had already been triggered) and, via the Schmidt trigger 59, clamping the output from the comparator 33 to prevent any alarm indication from being given whilst the setting operation is in progress.

In the circuit of Figure 3 the digital-to-analogue converter 38 and counter 39 of Figure 2 are replaced by two counters 39A and 39B the former of which receives clock signals on its input from the clock oscillator 43 and the latter of which receives input signals on its clock line from the most significant digit line 61 via resistors 62 from the counter 39A. The outputs from the counters 39A, 39B are supplied in pairs to an array of exclusive NOR gate circuits 63 which are gated via AND gate circuits 64 to a final output AND gate 65. This circuit operates to detect coincidence of the output signal values from the two counters 39A, 39B which, as will be appreciated, are connected so that the counter 39B counts one pulse each time the counter 39A is cycled through its whole count range. Each time coincidence of the count values in the counters 39A, 39B occurs the AND gate 65 produces a "high" output which is fed via a diode 66 to a centre biased Schmidt trigger 67 which also receives the output from line 61 representing the most significant digit counted by the counter 39A. The trigger 67 thus is periodically turned on by the output "high" signal from the AND gate 65 and, a predetermined time later, turned off by the output signal from line 61. These successive on and off switchings of the trigger 67, which in effect constitute an output square wave signal from trigger 67 are integrated by an output integrator comprising resistors 68, 69 and earthed capacitor 70, and the integrated signal is fed by line 71 to the inverting input of the comparator 33 the output from which is fed back through trigger 60 to the clock input of the second counter 39B. This counter is then stopped when the integrated output signal from the trigger 67 matches the value set by the strain gauge bridge, and although the oscillator 43 and counter 39A continue to cycle through their count continuously, the counter 39B remains inhibited at the count determined by the point at which it had reached when the comparator 33 produces its zero output signal representing coincidence.

When the load on the platform is correct, thereafter, the outputs from the discriminators 34, 35 are both high so that the output from the inverter 47 is low resulting in illumination of the green diode 50.

Via the two inverters 72, 73 the capacitor 53 is charged to maintain the output of inverter 74 low so that output of trigger 55 is high and output of trigger 75 is low. Now, if the weight on the platform changes, causing the bridge to become unbalanced and thus generate an output signal from the comparator 33, either the discriminator 34 or 35 goes low depending on whether the platform is loaded to a value above the set value or below the set value. For example, if the operator should leave the vehicle to collect bank notes from retail premises, the bridge becomes unbalanced and the discriminator 35 therefore goes low causing the output from inverter 47 to go high forward biasing the diode 51 and turning off by reverse biasing the green light emitting diode 50. The transistor 56 remains held in its non-conducting state, however, until the clutch pedal switch 52 is depressed discharging the capacitor 53 and allowing the inverter 74 to produce a high output to switch on the transistor and apply an alarm signal to the output terminal 57.

Claims

1. A security system for ensuring that a platform is correctly loaded, comprising weight sensor means sensitive to the laden weight of the platform when preliminarily check loaded, storage means for storing a value corresponding to the correct load, comparator means connected to the said weight sensor means and to the said storage means and operative, when energised, to provide an alarm signal if the weight sensed upon energisation does not lie within a predetermined range of the said preliminary check loading thereof.
2. A vehicle security system having a loadable platform, for ensuring that the vehicle is not driven without the correct load, comprising means sensitive to the applied load on the platform, operative to produce a signal representative thereof, means for storing data representing the correct load on the platform, means for comparing signals representing the instantaneous load and the stored load and an alarm system triggered by a sensor which detects if the vehicle is put in motion when the output from the comparison means represents substantial inequality in the two compared signals.
3. A vehicle security system as claimed in Claim 1 or Claim 2, in which there are provided means for resetting the said storage means to a new authorised load weight.
4. A vehicle security system as claimed in Claim 3, in which the said resetting means has an associated timer inhibiting its operation for a predetermined time interval after each operation.
5. A vehicle security system as claimed in Claim 4,

in which there are provided authorised timer override means to allow the resetting means to be operated within the said predetermined time interval.

6. A vehicle security system as claimed in any of Claims 3, 4 or 5, in which the said resetting means include means for generating a digital control signal and a memory for storing the digital control signal between successive resetting operations thereof.

7. A vehicle security system as claimed in Claim 6, in which the said means for generating a digital control signal comprise a counter supplied with a digital signal from a clock, means for providing a digitised weight signal representing the load on the platform during the resetting operation, comparator means for comparing the digital weight signal with the digital output signal from the counter, and means for inhibiting the clock when coincidence of the two signal values is detected.

8. A vehicle security system as claimed in Claim 7, in which the said counter also serves as the said storage means, providing a digital output signal representing the digital value counted at the time coincidence was detected with the platform load upon setting.

9. A vehicle security system as claimed in Claim 8, in which the output signal from the counter is supplied to a further comparator which also receives a signal representing the instantaneous load on the platform.

10. A vehicle security system as claimed in Claim 9, in which there are provided alarm inhibit means preventing operation of the alarm unless the vehicle is put in motion.

11. A vehicle security system as claimed in Claim 10, in which the alarm inhibit means are linked to the vehicle clutch pedal so that the alarm is armed as soon as the clutch pedal is depressed.

12. A vehicle security system as claimed in any preceding Claim, in which there are further provided time delay means to delay energisation of an alarm signal for a predetermined time after triggering.

13. A vehicle security system as claimed in Claim 12, in which the said time delay means are adjustable whereby to vary the delay time between triggering and energisation of the alarm signal.

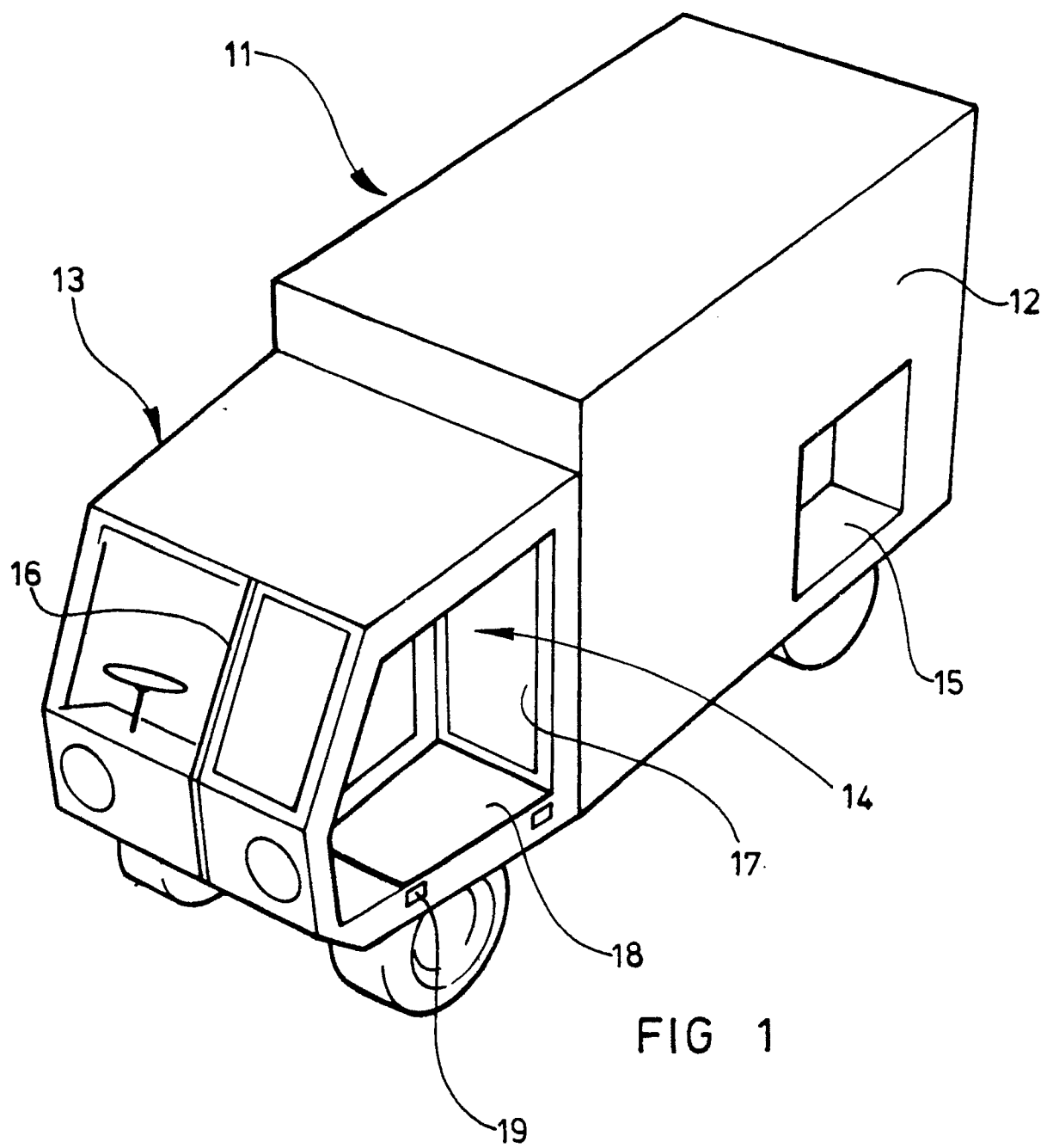
14. A vehicle security system as claimed in any of Claims 2 to 13, in which there are provided means for adjusting the load differential at which alarm triggering takes place.

15. A vehicle security system as claimed in any preceding Claim, in which the platform load sensors comprise a plurality of strain gauges in a bridge network.

16. A security system as claimed in Claim 1, in which the platform is a jeweller's tray, and there

are provided means for inhibiting the alarm by an authorisation key or code.

17. A security system substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.



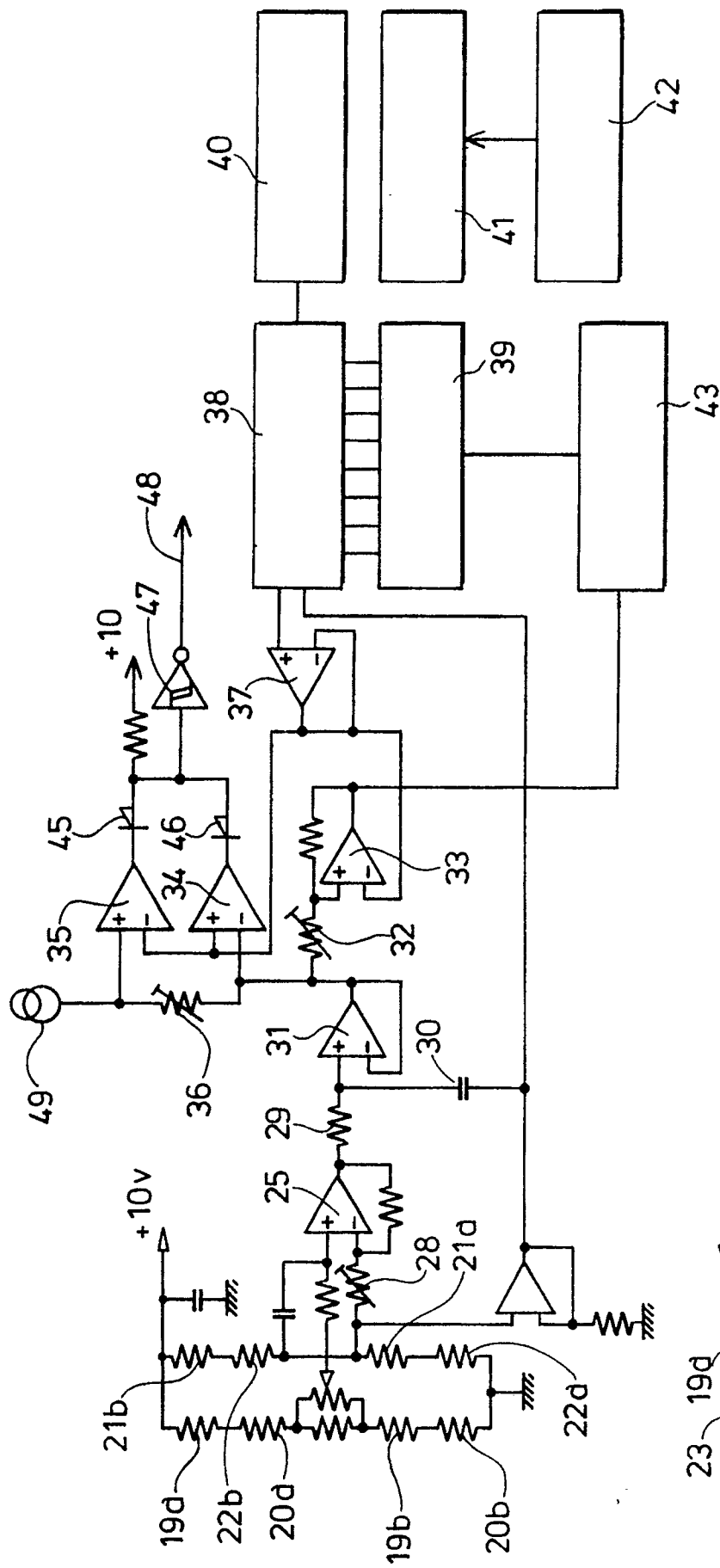


FIG 2

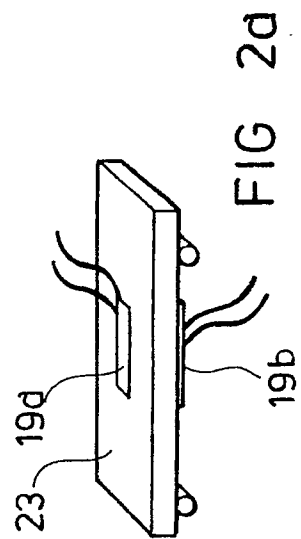


FIG 2d

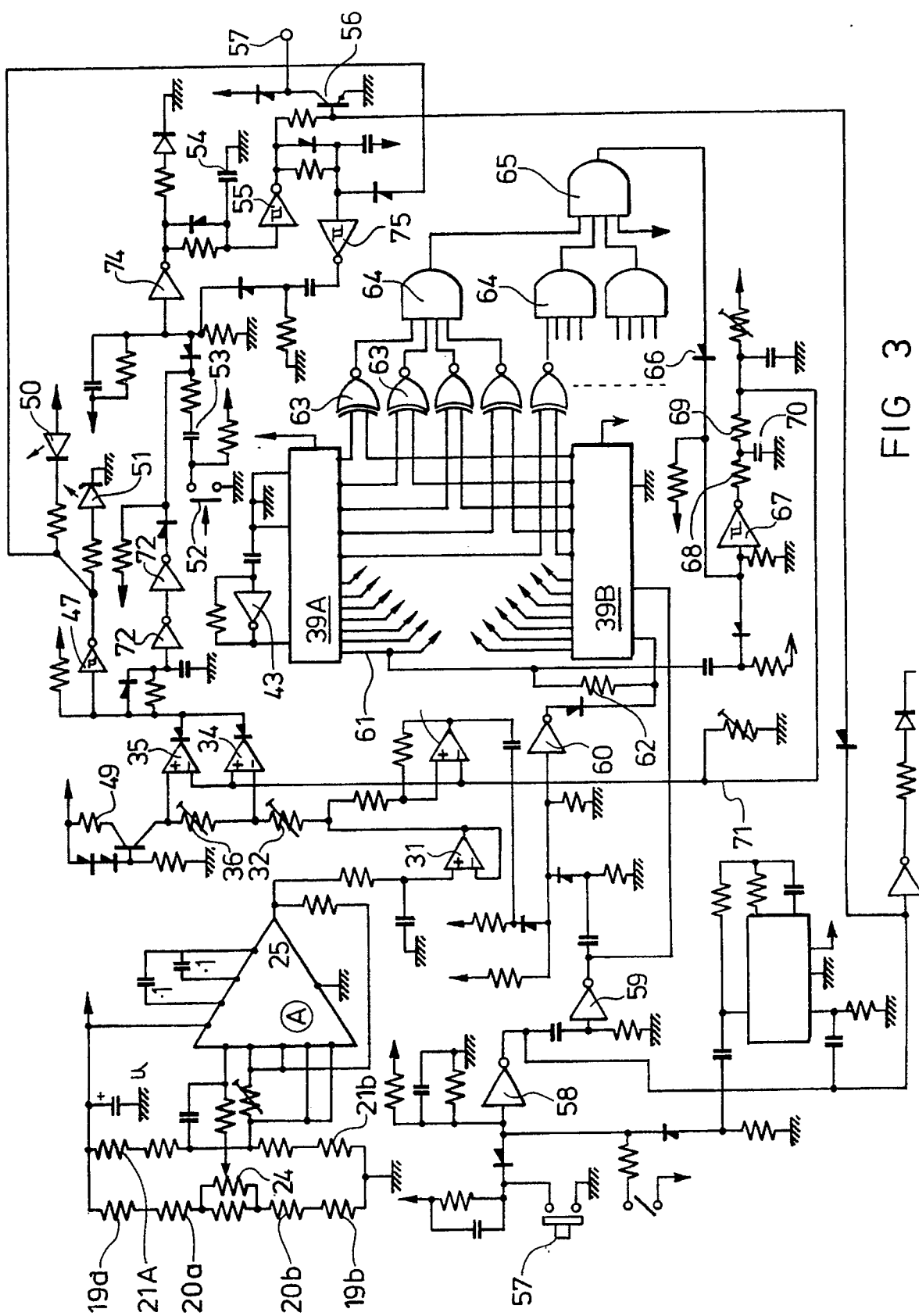


FIG 3