CONVENTION APPLICATION FOR A PATENT

We hereby apply for the grant of a Patent for an invention entitled:

PROCESS FOR SENSING AND CONTROLLING THE DECREASE OF ACTIVITY AND THE LEVEL OF ALERTNESS OF THE DRIVER OF A VEHICLE PROVIDED WITH AN INDEPENDENT ENERGY SOURCE, TRAVELLING ON AN UNBOUNDED PATH, AS WELL AS THE SAFETY EQUIPMENT FOR VEHICLES TRAVELLING ON AN UNBOUNDED PATH

which is described in the accompanying complete specification. This application is a Convention application and is based on the application numbered

for a patent or similar protection made in

on 29th November 1979.

My address for service is Messrs. Edwd. Waters & Sons, Patent Attorneys, 50 Queen Street, Melbourne, Victoria, Australia.

DATED this 1st day of December 1980.

To:

THE COMMISSIONER OF PATENTS.
In support of the Convention Application made by (1)

- ELEKTROMOBIL ELEKTRO- ES JARMUIPARI SZOVETKEZET

(hereinafter referred to as the applicant) for a Patent

for an invention entitled (2) PROCESS FOR SENSING AND
CONTROLLING THE DECREASE OF ACTIVITY AND THE LEVEL OF ALERTNESS
OF THE DRIVER OF A VEHICLE PROVIDED WITH AN INDEPENDENT ENERGY
SOURCE, TRAVELLING ON AN UNBOUNDED PATH, AS WELL AS THE SAFETY
EQUIPMENT FOR VEHICLES TRAVELLING ON AN UNBOUNDED PATH

I, (3) ARPAD HORVATH, of Elektromobil Elektro-

es Jarmuipari Szovetkezet, of 13, Meszaros Lorinc
utca, Gyor 9002, Hungary
do solemnly and sincerely declare as follows:

1. I am authorised by the applicant for the patent
to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was

made in (4) Hungary

on the 29th day of November 1979, by

ELEKTROMOBIL ELEKTRO- ES JARMUIPARI SZOVETKEZET


3. GYORGY BALogh, of 4, Borzsony utca, Budapest 1098,
MIKLOS HAJNAL, of 4/e, Tenkes utca, Budapest 1225, LASZLO VAJTA,
of 13, Czako utca, Budapest 1016, ISTVAN LOVANYI,
of 15, Felvinci utca, Budapest 1022, and LASZLO CSENKI, of
134/a, Vaci utca, Budapest 1135, all in Hungary

are the actual inventor(s) of the invention and the facts upon which the applicant
is entitled to make the application are as follow:

The applicant is the assignee of the said actual inventors


4. The basic application referred to in paragraph 2 of this Declaration
was the first application made in a Convention country in
respect of the invention the subject of the application.

DECLARED at Gyor, Hungary
this 6th day of January 1981.

To: THE COMMISSIONER OF PATENTS.
1. Process for sensing and controlling the decrease of activity and level of alertness of drivers of vehicles provided with an independent energy source and travelling on an unbounded path, especially in monotonous situations, characterized in that the changes in the energy household caused by the activity of the driver are observed, in accordance with the magnitude and speed of the changes signals are generated, by the aid of which the emission of the signals destined for the driver are interrupted, while in lack of the appearance of the changes taking place in the energy household on a proper level and for a predetermined duration instruction signal is given for the driver; when sensing the signals, the driver has to make the proper decision and to give the corresponding response-signal, whereas in lack of the response signal or in case of an erroneous response-signal an alarm signal in one or more stages is released.
PROCESS FOR SENSING AND CONTROLLING THE DECREASE OF ACTIVITY AND THE LEVEL OF ALERTNESS OF THE DRIVER OF A VEHICLE PROVIDED WITH AN INDEPENDENT ENERGY SOURCE, TRAVELLING ON AN UNBOUNDED PATH, AS WELL AS THE SAFETY EQUIPMENT FOR VEHICLES TRAVELLING ON AN UNBOUNDED PATH

The following statement is a full description of this invention, including the best method of performing it known to us:

1.
The invention relates to a process for sensing and controlling the decrease of activity of drivers of vehicles provided with an independent energy source and travelling on an unbounded path, especially in monotonous situation.

The invention also relates to a complex electronic safety equipment which is able to sense the decrease of activity of the driver of a vehicle provided with an independent energy source in course of the travel, simultaneously to control, to qualify and to register the ability for sensing and making a decision, the co-ordination of movements and the extent of attention.

By using the proper completing circuits, the equipment according to the invention may be rendered suitable for controlling the driver previous to putting the vehicle into operation in respect to alcoholic or pharmaceutical influence, at the same time the equipment is able to perform property protecting functions.

Although the process and the equipment have been primarily developed for road vehicles, especially automobiles travelling on public roads, both can be well used for controlling the alertness in case of any vehicle of transport, working machine, and at systems "man-machine" of continuous operation.

It is a well known fact, that the number of accidents resulting from inattention, tiredness, falling asleep etc. of the driver is far exceeding the number of accidents caused by technical faults.

The relating statistics are showing that in general
70% of the accidents may be attributed to these phenomena. About 20% of the accidents occurring on public roads in USA are the so-called "single-car" accidents, in causing of which no vehicles of transport were taking part beside the vehicle that has undergone the accident. Due to the increased number of vehicles, building of highways, the increase of the volume of transport taking place on public roads and restriction of speed all over the world one may reckon with the increase of accidents of the said character. It has been tried for a long time to ensure the alertness of the driver by means of an expedient "alertness controlling instrument" i.e. in case of decrease to avert the accident.

At one of the known technical solutions serving for this purpose, previously to the start of the vehicle an arithmetical task or a task requiring skill is to be performed with the aim to hinder the start of an extremely tired person or someone, who is influenced by alcohol or medicin. It is obvious that these instruments are absolutely unsuitable for controlling the tiredness in course of driving.

Several equipments have been developed, which are controlling the process of tiredness by controlling the cerebral waves, the movement of the eyes or the muscles. All these means suppose the wear of uncomfortable contacts on the body, as a consequence the did not come in general use.

It has been tried to produce stimuli in order to decrease monotony. Such an equipment is described in the specification of US-PS 3,611,344 /corresponding to the DE-PS 2 142 574/. This equipment is releasing periodically
repeated stimuli for the driver. The task of the driver lies in to extinguish the signal by using a manual switch. If it does not take place, the equipment stops the ignition of the motor or switches the emergency flashes. The drawback of the solution lies in that the rhythmic stimuli emitted are increasing monotony and when driving in the city and in endangering situation the stimuli may avert the attention of the driver.

The equipment used at railways, described in the DE-PS 1 199 312, is also serving for this purpose. This equipment is generating the warning signals in dependence of the speed of the vehicle, accordingly in a less foreseeable manner and rhythm; in connection with the so-called "dead-man" switch it is able to sense the decrease of the muscle-tone. Taking into consideration, that the equipment was developed for vehicles travelling on a bounded path - on a railroad - its application in road traffic becomes impossible.

With this last solution the inventions aiming the production of "awakening" signals arrived to the limit of their possibilities. Further trials have been directed to the observation of managing the steering-wheel /oscillation/. In this case the individual variation of the driving styles involved almost unsolvable problems. It became shortly obvious, that the values are depending on the weather, the condition of roads and the technical parameters of the vehicle to such an extent, that the simple counting of oscillation became almost senseless /such solutions have been

The tendency of further development of such equipments is represented by the solution having been specified in the DE-PS 2 404 963. It has been tried-by using the solution described-here to compare the measured oscillation values based on the samples taken in the single sections of the trip, however, this comparison could yield objective values only on long road-sections and with road-surfaces of constant quality.

The solution described in the DE-PS 2 042 853 is continuously controlling the quality of the correcting movements beside the oscillation value. If it were possible at all to take all these rapidly or slowly changing moments /e.g. the angle of inclination of the road, the quality of the tyres, ice, side-wind, the clearance of the steering-wheel, the load of the car etc./ into consideration, which are qualitatively determining the phenomenon of tiredness, objections could be raised in so far as the instruments mentioned before are sensing but the final state of the tiredness and do not take into consideration - they are not even able to do it - the peculiar anomalies of steering previous to falling asleep.

The equipment according to the US-PS 4 005 398 tries to reduce the chances of superfluous alarms resulting from the incompleteness of the method and involving risks of accident. In this solution essentially the characteristic features of the solutions described in the patents US-PS 4 031 527 and 3 322 639 have been combined. The basic
principle lies in that the manoeuvres of driving are counted in dependence of the speed, simultaneously the oscillation fluctuations of the steering-wheel are also observed. When one or the other of said data is falling below the threshold value, an acoustic signal for warning the driver is given. Thereafter the warning is automatically stopped.

At last - mainly due its original solution - attendance should be given to the equipment according to the US-PS 3,922 665. This equipment is sensing the increase of the threshold of hearing. The equipment is releasing a more and more intense acoustic stimulus for the driver, who has to extinguish the signal in the moment of sensing. Random character of the frequency of the stimuli is ensured by the fact, that the chance of occurrence is a function of the "sensing" period reckoned from the beginning of the generated signal to the moment of extinction. However, the threshold-value of hearing is changing at exhaustion - in most ranges of oscillation - just inversely, /accordingly, it is not increasing, but decreasing/ and its behaviour is influenced by numerous factors /not only by the level of the background-noise, which has been taken in consideration at our invention/, that we have almost no other choice, than to assume the view previously described in connection with oscillation of the steering wheel.

As a consequence, the common drawback of the described equipments lies in that they are not sensing the objective symptoms of tiredness, the stimuli produced with the aim to "shake up" the driver may disturb him in a
dangerous situation, besides the equipments proposed are too complicated and their universal application is impossible.

The solution described in the HU-PS 172 613 is more approximating the ergonomically optimal control of alertness. The most important characteristic of said solution lies in that the pulses coming from the sensors of other operating organs of the vehicle connected on other places /and serving for different purposes/ are immediately taken up into function with a "real time" character, excluding the possibility of distribution of attention. By means of this equipment a more objective phenomenon of tiredness - namely the extension of reaction time - may be controlled, i.e. the period, during which impulses are not arriving from the operating organs/ simultaneously the results are registered by means of expedient auxiliary devices.

However, the drawback of said equipment lies in that the connecting up of the sensors represents an utmost wearisome task, i.e. when only the minimally needed three points /the brake, the clutch, the steering-wheel or the index/ are connected up, the level of monotony ought to be observed for such a long unit of time, during which drop of attention could not be excluded. This problem pointedly arises at cars, which are working with an elastic output at different rates of speed. As a further object it can be raised, that a separate operating organ is needed for the response, while extension of reaction time can be evaluated within rather coarse limits only compared to the real biological scale of values.
The most important reason for the necessity for finding a more suitable solution, than those, previously described, lies in that in accordance with the modern theories on monotony the primary reason for tiredness and becoming apathetic may be explained with their "predicted character" beside the lack of stimuli, independent of their rhythm /within wide limits/, but depending on the fact, whether always identical, i.e. automatic reflex activity is produced. The solution according the Hungarian Patent No. 172 613—since the period passing till the warning signal is varied within narrow limits and always identical motion—reactions are required, cannot serve as an efficient weapon against monotony. Taking into consideration that only one single phenomenon of tiredness is observed, its extent of objectivity can be considered as sufficient only in comparison to other instruments.

The reasons described above led to the end avour to approach the control of the tiredness of the drivers on the way from a new side.

Almost every act of the driving process essentially consists of three biological phases: sensing, making a decision and handling.

In order to render this utmost complicated biological function "measurable" from several points of view, i.e. that we should be able to perform objective qualification, the following tasks have been set when designing the equipment and developing the process:

1. The process according to the invention and the equipment being suitable for performing said process should not dis-
turb the activity of the driver while driving, that is, it should perform its function only in traffic situations, when the number of stimuli compelling the driver to handle and the level of driving activity are anyhow low.

2. In an unexpected accident dangerous situation the instrument is not allowed to avert the attention of the driver.

3. In a monotonous situation the instrument should be able to control the actual circumstances in such a manner, that a warning signal of unexpected character should be given at random intervals; when sensing said signal, first of all the driver has to interpret the content of the signalization, he has to make the decision about the answer to be given, responding should take place by a /properly quick/ series of motions, which are suitable for being decomposed to its elements by means of the instrument.

On basis of the data measured in the described manner, the following data could be defined immediately and electrically;

a/ the reliability of sensing,
b/ the rightness of the decision /compliance with requirements/
c/ the rapidity of the reaction,
d/ the co-ordination of the movements and
e/ the state of the so-called own reflexes ensuring the finer co-ordination.

4. The equipment should give an unambiguous "backward-signal" about the result of the control that the driver should be
able to get synchronized with his own state of alertness and in knowledge of the same to chose the speed of drive or to stop.

5. The frequency of the controls should be in compliance with the decreasing or increasing level of alertness of the operator.

6. When sensing tiredness of a critical extent, the equipment should produce warning and alarming signals for calling the attention of the drivers in the environment to the danger or it should be able to stop the vehicle in said dangerous situations.

7. In order to be able to exclude senseless risk on behalf of the driver, the measuring results could be registered by means of suitable auxiliary equipment.

8. In lack of a suitable auxiliary equipment, the instrument should be able to store at least the dates of the last control /e.g. for routine controls on the public ways, for informing the controlling organs/.

9. Optionally the equipment could be rendered suitable to hinder the participation of a person being absolutely unsuitable for driving in traffic, previously to the start, in such a manner that only after having accurately and rapidly performed a task, which can be accomplished in a proper state of alertness only, starting of the vehicle should be possible.

10. Optionally the equipment should be suitable for the protection of properties, i.e. it should alarm at the incompetent opening of the parking car /or its luggage rack/
and ignition of the motor /without an alarm/ should be allowed only for a person knowing a special series of /electrical/ signals.

11. In a monotonous situation the equipment should possibly control the extent of alertness of the driver continuously and quite from the beginning.

12. The equipment could be universally used for passenger cars, lorries and working machines, respectively, independent of their mode of operation, and are increase of the number of the operating organs of the vehicle should be avoided.

13. Assembly should be simple /and non-professionals could be able to perform/, productions costs should enable its general and widespread use.

Both the process and the equipment, suitable for performing the process according to the invention are based on the fundamental recognition, that the level of activity of the driver and its decrease, respectively is not to be determined by means of sensors connected to operating organs, but by the observance and sensing the electrical changes taking place in the entire energy net - energy household - of the vehicle, having been restricted timely and in respect to the amplitudes, by using one single electrical connection.

In such a manner almost every motion of driving can be observed, so e.g. beginning from switching on the radio or using the cigarette-lighter, continued with the change in the number of revolutions of the motor, up to the use of the brake-lamps, the light-horn, the direction indicator, and the
lamp indicating reverse driving.

In order to avoid averting the attention of the driver in course of the control in an unexpected dangerous situation, /2. requirement/, the pulse of the sensing circuit observing the stability of the energy network /so e.g. braking, acceleration/ is accepted as a response in course of the control and measuring the alertness and simultaneously control is postponed.

Under monotonous circumstances /3. requirement/ /lack of pulses for at the most 120 seconds/, the alertness of the driver is controlled in the following manner:

after a previously not determined period, one of the indexcontrol lamps /RIGHT or LEFT/ on the instrument board is switched for maximally three seconds /in lack of such lamps one of the "instruction" lamps arranged on the frontal plate of the apparatus may be used for this purpose/. In course of switching a short "preparatory" horn call can to be heard. The right or left direction of the "instruction" lamp is not predictable, the mode of operation differs from the usuals, as a consequence in these cases a continuous light may be observed. The task of the driver is to put the arm of the direction indicator in the direction corresponding to the signal in the moment of sensing and to put it back immediately into its middle position.

During the performance of the series of response the equipment is measuring the following:

- the time elapsing between the beginning of the signal and the appearance of the response voltage expediently with
an accuracy of the hundreth of a second, /the so-called reaction time of selection/,
- the duration of the electric signal between switching of the direction indicator and taking back the same, representing a date being characteristic for the co-ordination of the series of motions and the quality of the own reflex-activity, and which is especially extended under the influence of alcohol; the identity of the direction of response-motion with that of the instruction is also observed.
- the overhasty or confused character of the motion based on the observation, whether the index-arm has stopped during displacement backward, or passing the middle, it has given a pulse also to the conductor on the opposite side.

In order to avoid the occurrence of an outer index-signal misleading the environment, the response-voltage is delayed for a predetermined duration /shorter, than 0,5 sec/, accordingly in this case the index-automaton is unable to switch. The to-day most frequently used hot-wire automatons are also working with such a delay and /under normal circumstances/ in 0,5 sec the motion of taking back can be performed without any difficulty.

The measuring results are evaluated in the equipment in a complex way, the single dates are weighted according to their driving function evaluated and signalled to the driver e.g. either by the combination of light-diodes of different colours /green, yellow, red/ or by means of a digital display /1 to 99/ /4. requirement/
A weighted evaluation can be solved e.g. in such a manner, that the duration needed for simple sensing resp. for reversing the direction of motions in order to perform taking back, is taken into consideration in a proportion 1:4, but compared to normal biological values; the response-motion having been performed in an unproper direction is signalled back as a "mesuring to be repeated", while the overrun motion is signalled back as an "insufficient" result.

When the driver becomes tired, the deterioration of the values measured en route by our equipment does not exceed e.g. 25%. In order to obtain better perceptibility of the process, it seems to be of greater use to employ a digital display, but a solution may be proposed too in sense of which, after every repeated switching, automatically a signal is released - compared to the following first measuring result - when the state of alertness of the driver decreases by more, than 20%.

In order to be able to avoid the misleading effect of the manoeuvres produced by the driver with the aim of a deliberate delay /which can be produced e.g. in such a manner, that in course of the control the instrument is silenced by means of a "consumer" pulse, e.g. by the use of the light -horn-/ such an absence of measuring is answered by the equipment according to the invention by a further measuring trial, being continued as long as a control being suitable for evaluating is appearing.

Simultaneously, the duration of the following "sensing of the level of activity" is also programmed electronically,
5. requirement/ and in an inverse ratio to the measured capacity of "alertness". /e.g. infinitely varied within the range between 8 and 120 seconds/.

In case if the driver did not give any response inspite of the "preparatory" horn-signal and the lighting of the "instruction" lamp for 3 seconds /6. requirement/ and no driving manoeuvre /i.e. a motion consuming electric current/ is performed, the equipment maintains the mode of measuring operation /= "repeated measuring"/ for a further two seconds, simultaneously releasing the horn-signal, hereafter - sensing the absence of response - the alarm is immediately taking place.

In course of the alarming activity the outer emergency flash-lights of the vehicle are switched-on, the horn is emitting a discontinuous sound, but in case of necessity the ignition of the engine can be interrupted and the brake put into operation. The alarming activity can be ceased only by stopping the vehicle.

The result obtained in course of the repeated measurement is reported by the equipment with the proper evaluation of the "fault points".

The measured results are registered on a circular diagram by the equipment in a manner being similar to that of the solution according to HU-PS 172 613, so e.g. by the control of the pulse transmitter of tachographs of the types Kienzle TCO 15-5 and TCO 15-6 /7. requirement/.

In case of vehicles not having been provided with a tachograph, the official acceptability of the measured results after an accident /or in course of a routine control
on the road/ are ensured by the equipment in such a manner, that the circuit surveying the "displey" of the existing last control is kept further on in operation by means of an independent supply voltage even after having switched-off the operational supply voltage applied in course of the travel /turning-off the ignition key, releasing the hand brake/. The requirement of input /power consumption/ of said circuit may be neglected and after having put the equipment repeatedly into operation, the last "stored" measuring result is automatically reproduced in a coloured or digital display /8. requirement/.

In the knowledge of the functions described, the equipment according to the invention can be made suitable for preventing the use of the car for incompetent persons or those staying under the influence of alcohol or medicaments /9. and 10. requirements/. Taking into consideration, that in course of the measurements taken en route, the equipment is evaluating the signals arriving from the switch of the direction indicator of the car as a response given by the driver to the warning signals, it is able to sense /and measure/ the order of sequence and duration of the voltages obtained by the signalling of the direction to the right or to the left even in a stationary position.

Accordingly, by applying convenient complements and programmes, the equipment can be completed by the following accessory functions:

When stopped, after having pressed a concealed
push-button, the equipment gets into a so-called "state of vigilance". In this case its supply voltage is independent of the ignition-key, and the energy requirement of the functioning circuits can be neglected. In the next phase, under the influence of the second "consumer's signal" obtained at any time on the sensor serving for the observance of the activity signal in course of the control of alertness -/the first one can be e.g. the illumination of the inner space of the car, switched on, when the driver left the car/, the equipment turns to the so-called "identifying" mode of operation. In course of this the equipment awaits /e.g. for 5 to 15 seconds/ the performance of the sequence of special movements, i.e. the beginning of the same, from the person who is seemingly climbing into the car.

This sequence of motions is nothing but switching the arm of the direction indicator at least four times, but exclusively in the order of sequence having been coded into the equipment /play back of a code/.

The change of the directions to the right or to the left four times is yielding 16 combinations of the signals, out of these only one will always represent the "key" of a given car.

Reckoned from the first index-signal /of proper direction/ the equipment begins to measure the time elapsing till the fourth /last/ signal. If this value exceeds a biologically acceptable minimal level, the fact of unfitness will be made probable /≈ about 3.5 seconds/. In this case the cycle with the "identifying" phase is started as many
times as the suitable measuring result is obtained.

In case, if within the "identifying phase" one single displacement in the wrong direction is sensed, our equipment immediately concludes to the fact of "incompetence". When the proper signals are not coded into the equipment during the waiting time of the "identifying phase", incompetence will be supposed. The same happens, when reckoned from the beginning a newer Consumer's pulse is arriving from the sensor /e.g. the use of a starter/.

After having stated the fact of incompetence, the equipment automatically switches to the previously described alarm-operation /emergency flash-lamps, outer horn/, but it may finally break the circuit of ignition.

Alarming can be stopped only by repeated pressing of the hidden push-button. A repeated use of the same, however, is starting only from beginning the phase of vigilance.

Thereby, that the push-button does not finally exclude this function, the effect may be achieved, in so far as the driver staying under the influence of alcohol is unable to start the car neither in the knowledge of the place of the button. /Should somebody not press the hidden button, when stopping the car, he takes the risk of theft on himself/. The change of at least four directions of motion within about 3,5 seconds - to be performed in predetermined directions - as well as coding requiring continuous concentration, are representing rather complicated tasks as to be performed by a drunken man.

For the sake of order it should be mentioned, that
no special operating organ within the car is needed, since control takes place by means of the arm of the direction indicator.

Taking the above mentioned into consideration, our invention relates to a process for sensing and controlling the decrease of activity and the level of alertness of the driver of vehicles provided with an independent energy source and travelling on an unbounded path, especially in monotonous situations, in course of which the changes in the energy household of the car caused by the driving activity of the driver are observed and signals corresponding to the speed and magnitude of said changes are generated, by the aid of which the emission of the signals destined for the driver are suspended, in lack of the appearance of the changes taking place in the energy household on a proper level and for a predetermined duration, an instruction signal is given for the driver. When sensing these signals, the driver has to make the proper decision and to give the corresponding response-signal, in lack of the response-signal or in case of an erroneous signal, an alarm signal in one or two stages is released.

The safety equipment being suitable for performing the process according to the invention is also forming the object of our invention. It is an equipment provided with an independent energy source and the usual circuit-outfittings /e.g. ignition switch, handbrake - control lamp, horn, lighting, a direction indicator switch and any electrical consumer needed for the operation of the vehicle/, to be used
for cars travelling on an unbounded path, which is well suitable for the control of the tiredness of the driver, especially in monotonous situations, taking the speed and the magnitude of the changes in electrical consumption caused by the activity of the driver into consideration. The equipment contains an arrangement generating the warning signal for the driver and a circuit-arrangement for generating the response-signal, to be actuated by the driver, furthermore it contains lamps for signalling the instructions, eventually a registering apparatus; optionally the equipment may be completed with an circuit-arrangement for controlling the driving ability of the driver at the start /whether he is staying under the influence of alcohol or medicaments/ and yielding protection against incompetent intrusion. The equipment can be characterized in that to the terminal /unearthed, not connected to a body/ of an accumulator /AKKÜ/ as energy source or to a conductor connected to the unearthed terminal and leading to the consumers, a circuit has been connected for observing the changes in current, on which the current of the consumers is streaming, the selective signal outputs of which are connected to signal lamps signalling the instructions, so e.g. index-control lamps, "instruction" lamps, which against are connected to the selecting circuits of the selecting switch for forwarding the response of the driver.

The process and the equipment according to the invention will be described in details by means of a preferred embodiment, by the aid of the accompanying drawings. Wherein
Figure 1 is showing the block schematic of a solution according to the invention,

Figures 2 to 5 are showing solutions for the blocks of the arrangement according to figure 1, serving as an example,

Figure 6 is showing the circuit arrangement forming an accessory part of the equipment, serving for the control of the suitability of the driver and protection against incompetent intrusion.

Essentially, the drawing is showing a solution relating to a car.

In the block schematic illustrated in figure 1 one of the terminals of the accumulator AKKU representing the energy source is connected to the body, while to the other terminal a section 18 of the conductor is connected. The current is flowing through said conductor to the different consumers. On one hand the supply voltage of the vehicle, and on the other the terminals of the equipment according to the invention are connected through the ignition switch 1 and the hand-brake switch 2. The equipment itself consists of three parts, namely the signalling part, the controlling part and the displaying and operating part. The equipment described here as an example, comprises a sensing circuit 4 sensing the magnitude and speed of the current changes.

A counter 3 counting the level of activity is connected to said sensing circuit 4, while - by interposing a delay circuit 9 - a direction indicator switch 8 is connected to a circuit 10 measuring the reaction time, whereas the circuit
10 is connected by means of a bilateral connection to the counter 3 counting the level of activity.

An alarm unit 13 is connected to the circuit 10 measuring the reaction time, the output thereof is connected to a flashing automaton 14, the output of which is connected to the outer emergency flashlights 15 of the vehicle. Instruction-signallamps 5 and 6, a horn 7, a display 11 and a tachograph 12 are also connected to the circuit 10 measuring the reaction time.

In figure 1 a vigilance-counter 17 has been also illustrated, which can be operated by means of a push-button 16. The vigilance-counter 17 is essentially forming the basis of a circuit protecting against incompetent intrusion and a circuit controlling the state of the driver.

After having switched the ignition switch 1 to be seen in figure 1 and actuated the hand-brake switch 2 - which is closed by releasing the hand-brake - the equipment sensing and controlling the decrease of the activity and level of alertness of the driver is put into operation, that means that the counter 3 counting the activity level begins to work. The sensing circuit 4 is sensing the speed and the magnitude of the change in the current flowing through the section 18 of the conductor and gives pulses - being in compliance with the sensed values - to the counter 3. The counter 3 counting the activity level becomes always balanced to "null" under the influence of the pulses coming from the sensing circuit and generated by the driving activity of the driver. In lack of such a pulse, after the
expiration of a predetermined period, one of the instruction lamps 5, 6 lights up, simultaneously the horn 7 is also emitting a sound. In order to answer the instructions, the driver has to make the decision and turn the direction indicator switch 8 in the direction corresponding to the instruction of the lighting lamp, then put it back immediately in its middle-position without lighting up of the outer direction indicating lamps. In a given case the instruction lamps may be substituted by the control lights showing the direction, when separate control lamps are staying at disposal for both directions. The response signal arriving from the direction indicator switch 8 will be evaluated by means of the circuit 10 measuring the reaction time by interposing the delay circuit 9. On basis of the evaluation proper signals are led to the display 11 and the tachograph 12. Simultaneously, the duration of activity level to be considered next time at the counter 3 counting the activity level is also programmed. During the measuring process any pulse coming from the sensing circuit 4 causes a delay.

If the driver is giving an improper answer or he does not give an answer at all, - improper answer is given by turning the arm of the direction indicator switch 8 into the faulty direction -, the alarm unit 13 becomes activated and puts the outer emergency flashlights 15 into operation through the flashing automaton 14.

Furtheron - possible embodiments of the single blocks of the arrangement illustrated in figure 1 will be
described.

In figure 2 a possible embodiment of the sensing circuit 4 may be seen.

At our example the input signal of the sensing circuit 4 sensing the changes in current is delivered by the voltage drop on the section of the conductor 18. A low-pass filter and divider circuit 19 ensures the elimination of the high-frequency noise resulting from ignition and other sources. After having brought to the corresponding signal level by means of the differential amplifier 20 and after separation the low-frequency changes, occurring within the current household of the vehicle - switching in and off the consumers - may be detected by the aid of a sampling and holding circuit 21. By the expedient choice of the period of sampling /clock pulse/ generated by a clock pulse generator 42 changes in the voltage of different speeds /magnitudes/ can be discriminated.

Under the influence of the sensed changes in voltage the differentiating circuit 22 delivers the pulses needed for starting the monostable circuit 22. Within this block the lower threshold value of the magnitude of the change in voltage taking place during the sampling period, under which the monostable circuit 23 does not function.

The possibilities of intervention enumerated here ensure the discrimination of the connected consumers and driving activities, respectively, on basis of the speed and magnitude of the changes in voltage.

The voltage arriving to the input of the sensing
circuit 4 contains the voltage drop depending on load, arising on the internal resistance of the accumulator AKKU and on the interposed section of the conductor 18 /which can be e.g. the cable between the accumulator and the ignition switch 1/, as a consequence, it is well suitable for sensing all the activities of the driver, which involve the switching of the electrical consumers. These are the following /taking the approximative values as a basis and related to a passenger car:/

- ignition 50 W
- self-starter 1.3 kW
- horn 60 W
- brake lamp 42 W
- index lamp 50 W
- subdued - town - long-
  - distance light 100/20/100 W
- light horn 90 W
- heating 20 W
- windscreen wiper 25 W
- optional other consumers

Beside the consumers enumerated the sensing circuit 4 is sensing the quick changes in the electrical net of the vehicle caused by a sudden change of the number of revolutions. Simultaneously the state of the small-consumers /e.g. control lamps, oil pressure indicator/ is left out of consideration. This is mostly motivated by the fact, in so far as the change does not take place as a consequence of the activity of the driver /e.g. the rate of power input
of the radio.

In order to ensure the possibility of application in cars of different types, the minimal sensed voltage can be adjusted by adjusting the amplifying factor of the differential amplifier 20 and of the comparing level of the comparator input of the monostable circuit 23, whereas the speed can be adjusted by the proper chose of the sampling frequency /at a higher frequency the sensing circuit 4 is sensing quicker changes/.

The section of the conductor 18 is formed preferably by the cable between the accumulator AKKU and the ignition switch 1, at the same time the change of the consumption can be well characterized by the change of the consumption on the non-earthed point of the accumulator /in general the positive terminal/.

On the input of the low-pass filter and divider circuit 19 there is a resistor divider with a dividing rate of about 1:2 arranged, furthermore it contains a filter with a cutoff frequency of about 10 Hz, having been assembled from an operation amplifier, which is simultaneously performing the task of the differential amplifier 20. In such a manner the low-pass filter and divider circuit 19 and the differential amplifier 20 are advantageously forming one single unit.

On the input of the sampling-holding circuit 21 there is e.g. a FET-switch, which is switched by the clock signal of approximately 1 Hz. The clock signal is generated by a clock signal generator 42. The input switch is transferring the output of the differential amplifier 20
with a given frequency onto a condenser, besides it ensures a high-impedance separation. The voltage of the condenser is forwarded by a FET output stage towards the differentiating circuit 22. At the most simple embodiment this is a RC-member, which is producing a pulse from the voltage skip.

The input stage of the monostable circuit 23 is formed by a comparator circuit, which does not allow to pass the pulses below a certain predetermined level into the starting circuit of the monostable circuit 23. The latter one is a transistorized or integrated basic circuit arrangement which can be started both with a negative and a positive pulse.

The equipment awaits the response-signal of the driver on the direction indicator switch 8 in the phase of the control of the level of alertness. In order to prevent superfluous outer direction indication, the delaying circuit 9 has been interposed - as already mentioned - between the flashing automaton 14 and the direction indicator switch 8. The delaying circuit 9 allows to prevail the closing of one of the contacts of the direction indicator switch 8 on the input of the flashing automaton 14 with a delay of max. 0.8 sec in such a manner, that the monostable circuit 24 arranged within the delay circuit 9, which is starting upon the activation of the direction indicator switch 8, is interrupting the connection between the direction indicator switch 8 and the flashing automaton 14 for the period mentioned above, by actuating an interrupting/connecting/circuit 25, either by using relais or semi-conductors.
The frequency of the control of the level of alertness depends on the activity level of the driver. The counter 3 counting the activity level is serving for the control of the frequency of the supervision. This may consist of a programmable counter 26 /figure 4/, which is present under the influence of the pulses arriving from the sensing circuit 4 to an initial value determined by the result of the previous measuring process. As a consequence, the programmable counter 26 receiving the signals of the low frequency clock pulse generator is reaching its saturated state only then, if a pulse indicating a driving activity does not arrive for a period being characteristic for the activity level.

A more serviceable solution lies in, when the interval between two measuring processes is restricted by an upper limit, e.g. in such a manner, that after a certain number of pulses arriving from the sensing circuit 4 the counter is not present anymore to the originally defined initial value, but only a short delay is allowed till the beginning of the measuring process.

After having reached the saturation level of the programmable counter 26 of the counter 3 counting the level of activity, the measuring phase is started. This phase is beginning with a short sound of the horn 7 and with the random lighting up of one of the instruction lamps 5,6.

The random character is obtained by the circuit 10 measuring the reaction time /figure 1/ e.g. in such a manner,
that the pulses arriving from the sensing circuit 4 are tilting the bistable circuit 28 and the output thereof is selecting the signal lamp 5 or 6 to be lighted (figure 3).

For the sake of order we wish to remark, that the part 10a of the circuit 10 measuring the reaction time is to be seen in figure 3, while the part 10b thereof is illustrated in figure 5.

Evaluation of measuring takes place by means of the parts 10a and 10b of the circuit 10 measuring the reaction time. Qualification is the result of weighting the measuring results of four different parameters. These data are the following:

- the counter 29 is measuring the time elapsed between the beginning of the measuring process and the appearance of the answer; for the duration of the measuring the activating and storing unit 41 is activating the "clock" input of the counter 29;
- the length of the response-pulse is measured by the counter 30.
- The correctness or uncorrectness of the response-pulse is detected by the combination net 31 (figure 3/) comparing the output of the bistable circuit 28 with the response pulse.
- The co-ordinated character of the response-motion, i.e. the appearance of the pulse following the answer within a short time, coming from the opposite side, is controlled by the monostable circuit 32 starting upon ceasing the response-pulse (figure 5/).
The clock-pulse of the counters 29 and 30 serving for measuring the time, generated by the clock-pulse generator 33, has been selected for 1 kHz, enabling a resolution of 0.001 sec. The arithmetic unit 34 illustrated in figure 5 determines the qualification on basis of the contents of the counters 29 and 30, weighting the values under the conditions of the combination net 31 and the monostable circuit 32. In respect to current supply the storing element 35 storing said data, is independent of the position of the ignition switch and enables the storing of the last measuring result.

For displaying the measuring result any type of display 11 can be used, expediently a digital display is used.

For registering the pulse being proportional to the measured result on the tachograph 12, the monostable circuit 36 can be advantageously used, the timing of which is depending on the measuring results, while the start is synchronized with the end of the measuring process. /The tachograph 12 may also work with pulse with modulated signals/.

The part 10b of the circuit 10 measuring the response time - which is an evaluating unit - is actuating the alarm unit 13 in an overflow state of the counter 30 /an answer did not arrive/. Overflow of the counter 30 /presumably no answer was given, but the indication of the direction took place/, respectively, the pulse coming from the sensing circuit cause the delay of the measuring process /figure 4/. In the state of vigilance the function of the vigilance counter 17 according to figure 1 is to sense the correctness
of the code-combination "played back" by the driver. A possible mode of realization lies in that the direction of the correct response is defined by the output of a multiplexer 37 /from 4 to 1, in a general case from n to 1/. The multiplexer-addressing, counting circuit 38 is incremented by the actuation of the direction indicator switch 8 in any of the directions. The inputs of the multiplexer 37 are connected to the logical level "0" resp. "1" and thereafter the desired sequence is set /programmed/. /figure 6/.

The input of the vigilance counter 17 is formed by a counter 43, to which the timing, consisting of the monostable circuits 39 and 40 is connected. Under the influence of the second pulse coming from the sensing circuit 4, following the switching to the state of vigilance, the first monostable circuit 39 is starting, and after the expiration of timing it is switching to alarm, if only playing back of the code has not begun. The playing back of the code-combination is starting the second monostable circuit 40, which at the end of timing is switching to the alarm via the flip-flop 44, if only playing back of the code - setting the flip-flop 45 - has not been finished. On the other hand the output connected to the alarm unit 13 will be immediately activated via the flip-flop 45 when the code is played back in a wrong way. The alarm taking place under any condition, activates the alarm unit 13 according to figure 1, which is switching the emergency flaslights 15 and the horn 7 of the car via the flashing automaton 14. When the alarm unit 13 is activated upon the absence of the answer, inactivation may
take place via the handbrake-switch 2 only, whereas in a state of vigilance inactivation becomes possible through the hidden push-button 16. It goes without saying, that in this case the vigilance counter 17 is repeatedly getting in an activated state.

In the drawings the theoretically needed AND-connections El.....E10, the OR-connections V1.....V5, as well as the inverter I are indicated.

The solutions illustrated in the drawings, serving as an example, contain the essential directives, on the basis thereof any technician is able to realize the object of the invention without difficulties, while the single variations can be easily realized by taking the theoretical drawings into consideration.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Process for sensing and controlling the decrease of activity and level of alertness of drivers of vehicles provided with an independent energy source and travelling on an unbounded path, especially in monotonous situations, characterized in that the changes in the energy household caused by the activity of the driver are observed, in accordance with the magnitude and speed of the changes signals are generated, by the aid of which the emission of the signals destined for the driver are interrupted, while in lack of the appearance of the changes taking place in the energy household on a proper level and for a predetermined duration instruction signal is given for the driver; when sensing the signals, the driver has to make the proper decision and to give the corresponding response-signal, whereas in lack of the response signal or in case of an erroneous response-signal an alarm signal in one or more stages is released.

2. Process as claimed in claim 1, characterized in that the changes occurring in the energy household are observed on basis of the changes of the current within an electric conductor section.

3. Process as claimed in claim 1 or 2, characterized in that an informative display is given for the driver, which is always in compliance with his prevailing level of alertness.

4. Safety equipment for vehicles travelling on an
unbounded path, provided with an independent energy source and the usual circuit-outfittings /e.g. ignition-switch, hand-brake control lamp, a horn, lighting means, a direction indicator switch and any electrical consumer needed for the operation of the vehicle/, which is suitable for the control of the tiredness of the driver, especially in monotonous circumstances, taking the speed and magnitude of the changes in electrical consumption caused by the activity of the driver into consideration, furthermore said equipment contains a circuit-arrangement for generating warning signals for the driver and for generating a response-signal, the latter one to be actuated by the driver, instruction-lamps, possibly a registering apparatus; optionally it may be completed with a circuit arrangement for the control of the driving ability of the driver at the start /whether he is staying under the influence of alcohol or medicaments/ and yielding protection against incompetent intrusion, characterized in that to the unearthed /not connected to body/ terminal of the energy source - the accumulator /AKKU/ or to the conductor connected to the unearthed terminal and leading to the consumers a circuit /18/ has been connected for observing the changes in current, on which the current of the consumers is flowing, the signal outputs according to selection of which are connected to signal lamps, signalling the instructions, so e.g. index-control-lamps, instruction-lamps /5,6/, which again are connected to the selecting circuits of the selecting switch for forwarding the response of the driver.
5. Equipment as claimed in claim 4, characterized in that the selecting switch of the responding unit is the direction indicator switch of the vehicle /8/ itself.

6. Equipment as claimed in claim 4 or 5, characterized in that the input of a circuit /4/ sensing the magnitude and speed of the change in current in the section of said conductor /18/ leading the current of the consumers is connected to the unearthed /not connected to the body/ terminal of the energy source - an accumulator /AKKU/ - or to the unearthed terminal, while the output of the same is connected to the input of an activity level counter /3/, the activity-level counter /3/ is connected through a two-way connection to a circuit /10/ measuring the reaction time and the inputs of the same are connected by interposing a delay circuit /9/ to the terminals of a direction indicator switch /8/, furtheron to the output of the circuit /10/ measuring the reaction time instruction-lamps /5,6/, a horn /7/ and a display /11/, as well as a registrating apparatus, e.g. a tachograph /12/ are connected together with the input of an alarm unit /13/, while the output of the latter one is connected to the input of a flashing-automaton /14/ and the output thereof is connected to emergency flashlights /15/.

7. Equipment as claimed in claim 6, characterized, in that the input of the sensing circuit /4/ is formed by a low-pass filter and divider circuit /19/ and by a differential amplifier /20/ connected
to said low-pass filter and divider /19/ possibly forming an unit with the aforementioned, to which the input of a sampling-holding circuit /21/ has been connected, while the output thereof is connected via a differentiating circuit /22/ and a monostable circuit /23/ to the input of the activity-level counter /3/, while simultaneously to the other input of the sampling-holding circuit /21/ the output of a low-frequency clock-pulse generator /42/ is connected.

8. Equipment as claimed in claim 7, characterized in that the low-pass filter and divider circuit /19/ and the differential amplifier /20/ forming an unit with the former ones contains a resistor divider with rate of about 1:2 and an active filter with a cut-off frequency of 10 Hz assembled of an operation amplifier.

9. Equipment as claimed in claim 7, characterized in that on the input of the sampling-holding circuit /21/ there is a FET-switch arranged, to the control input of which a clock-pulse generator /42/ has been connected, while between the output and the input of the FET-switch an condenser-stage has been connected.

10. Equipment as claimed in claim 7, characterized in that its monostable circuit /23/ is a comparator-circuit determining the minimal starting impulse level.

11. The equipment as claimed in claim 6, characterized in that the delay-circuit /9/
having been interposed between the direction indicator switch /8/ and the flashing automaton /14/ consists of a monostable circuit /24/ connected to an interrupting-connecting circuit /25/.

12. Equipment as claimed in claim 6, characterized in that the activity-level counter /3/ controlling the frequency of the controlling process, comprises a programmable counter /26/, to the "clock" input of which the output of the low-frequency clock-pulse generator /27/ is connected, while to the input "load" the output of an OR-circuit /V2/ - connected to the output of a delaying counter /30/ of the circuit /10b/ measuring the reaction time and of the sensing circuit /4/ - is connected, simultaneously to the input /INPUT/ of the same the "measuring result" output of the storing element /35/ of the circuit /10b/ measuring the reaction time is connected, at last the output "saturation" is connected to the "measuring" input of the circuit /10a/ measuring the reaction time.

13. Equipment as claimed in claim 6, characterized in that the circuit /10a/ measuring the reaction time is containing a bistable circuit /28/, the input of which is connected to the output of the sensing circuit /4/, while the outputs are connected to the instruction -lamps /5,6/ via an AND-connection each /El, E2/, while the other inputs of said AND-connections /El, E2/ are connected to the "saturation" output of the programmable counter /26/ of the activity-
-level counter /3/, furtheron the outputs of said AND-connections /E1, E2/ are connected to an input each of further AND-connections /E3, E4/ whereas to the other inputs thereof a terminal each of the direction indicator switch /S/ is connected and the outputs of the further AND-connections /E3, E4/ are connected to the inputs of the combination net /31/ detecting the correct/incorrect response.

14. Equipment as claimed in claim 13, characterized in that the circuit /10b/ measuring the reaction time is simultaneously an evaluating and weighting circuit, the input of which being connected to the "saturation" output of the programmable counter /26/ and its input is connected partly via an activating-storing unit /41/, partly directly, together with the output of a clock-pulse generator /33/ to the input of an AND-connection /E5/, while the output of it is connected to the clock-input of a counter /29/ counting the time elapsing between the beginning of the measuring process and the appearance of the response, simultaneously the "saturation" output of said counter /29/ is connected to the alarm unit /13/, furtheron the output of the OR-connection /V3/ connected to the "clear" input of the activating-storing unit /41/ and the output of the clock-pulse generator /33/ are connected via an AND-connection /E6/ to the "clock" input of a counter /30/ measuring the length of the response-pulse and the "saturation" output of the same counter /30/ is connected to the "delay" input of the activity-level
counter /3/, while the "clear" inputs of said two counters /29, 30/ are connected to the "saturation" output of the programmable counter /26/; the terminals of the direction indicator switch /8/ are connected via the OR-connection /V3/ and the monostable circuit /32/ to one of the inputs of an AND-connection /E7/, to the other input of which the output of the OR-connection /V3/ has been directly connected; by interposing the monostable circuits /32/ and the AND-connection /E7/ the outputs of the counters /29, 30/ and of the combination net /31/ are connected to the input of the arithmetic unit /34/, whereas the output of the latter one has been connected to the alarm unit /13/.

15. The equipment according to claim 14, characterized in that a storing element /35/ is connected to the arithmetic unit /34/ and the output of said storing element is connected partly to the input of the programmable counter /26/, partly to the display /11/ displaying the result of the measuring process, furtheron via the monostable circuit /36/ with changing timing it is connected to the registrating apparatus, advantageously a tachograph /12/, while the other input of the monostable circuit /36/ with the changeable timing is connected to the "saturation" output of the programmable counter /26/.

16. The equipment as claimed in claim 6, characterized in that it is containing a circuit-arrangement controlling the driving ability of the driver previously to starting and yielding protection
against incompetent intrusion, provided with an activating element, e.g. a push-button /16/ being connected into the circuit of a vigilance counter /17/, simultaneously the input of the vigilance counter /17/ has been connected to the output of the sensing circuit /4/ sensing the magnitude and speed of the change in voltage, while the outputs of the same are connected to an input each of the direction indicator switch /8/, of the delay circuit /9/, the alarm unit /13/ and the circuit /10/ measuring the reaction time.

17. Equipment as claimed in claim 16, characterized in that by interposing an OR-connection /V5/, via the multiplexer-addressing, counting circuit /38/ the input of a multiplexer /37/ "from n to 1" is connected to the terminals of the direction indicator switch /8/; the output of the sensing circuit /4/ is connected by interposing the counting circuit /43/ to the timing circuit incorporating two monostable circuits /39, 40/ connected in series, and the output of said timing circuit as well as the output of the multiplexer /37/ are connected via the logical net /I, E9, E9, V4, E 10/, as well as through two flip-flops /44, 45/ connected in series to the alarm unit /13/, whereas the "clear" input of the first flip-flop /44/ is connected to the output of the circuit /38/ addressing the multiplexer /37/ and the input "clear" of the second flip-flop /45/ is connected to the activating switching element, the push-button /16/. 
DATED this 1st day of December 1980.

ELEKTROMOBIL ELEKTRO- ES JARMUIPARI SZOVETKEZET

EDWD. WATERS & SONS
PATENT ATTORNEYS
50 QUEEN STREET
MELBOURNE, VIC. 3000.
Fig. 1

supply voltage

consumption

control part

indicating and actuating part
Fig.1

- AKKU
- Supply voltage
- Consumption
- Control part
- Indicating and actuating part

Numbers and labels correspond to components in the diagram.
generator

AKKU

consumption

18

19

20

21

22

23

42

clock

Fig. 2
Fig. 2
Fig. 3
Fig. 4

measuring result (from 35)

INPUT
Clock saturation
Load

26

measuring starts

V2

delay (from 30)

4

27
measuring result (from 35)

Fig. 4