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(54) Safety wear.

(57) Safety wear for recognizing a pedestrian after dark by a driver of a motor vehicle to thereby avoid an accident. Light producing elements (22, 24, 26, 40, 42, 44, 46, 34, 36, 50, 52) are provided at a majority of the major joints of the wearer to enable instant recognition responsive to the biological movements of the wearer and without the need for special training or education.

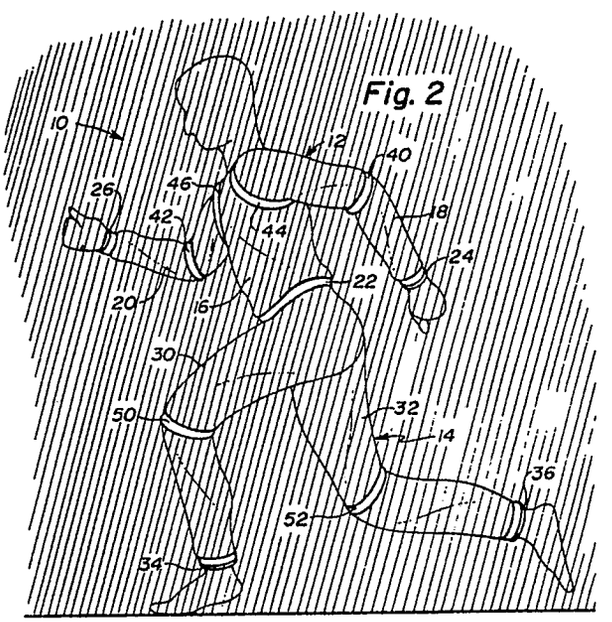


Fig. 2

EP 0 383 478 A1

SAFETY WEAR

This invention relates to Safety Wear which provides optimal visibility of humans at night. The invention utilizes a configuration of luminous or retroreflective points that create the powerful perceptual properties of "biological motion." By virtue of biological motion, this innovation permits instantaneous perception of any moving wearer and of the wearer's actions in a dark environment. A primary application is to enhance pedestrian safety at night.

Every year, thousands of pedestrians are killed in the United States by being struck by motor vehicles. Other thousands are severely injured.

Although statistical data are incomplete, certain studies indicate that the rate of nighttime pedestrian accidents is ten times higher than the rate of daytime accidents. A pedestrian in dim light or in darkness is hit because the driver did not see the person in time, or at all. The greater the distance between the driver and the pedestrian at the time of recognition, the greater is the likelihood that an accident can be avoided. Once a driver recognizes an object as a pedestrian, he or she can immediately exercise appropriate caution to avoid a mishap.

Vehicle speed is an important factor in pedestrian accidents. The faster a car is travelling, the faster the car reaches the pedestrian; also, the longer it takes for the car to be stopped. For example, if one assumes the driver's perception and response time is 2.0 seconds, it can take more than 100 feet to stop an automobile travelling only 25 mph. The same car going 55 miles per hour can take more than 300 feet to stop.

Another less obvious but critical factor for nighttime highway safety is visual conspicuousness. The term "conspicuousness" refers to the "noticeability" of any potential hazard or obstacle in the highway environment. More specifically, it denotes the level of visual recognition both of the potential hazard and of any changes in its status, position, or behavior relative to other highway users. It is obviously necessary at all times to assure that any driver should be able to detect the presence and to recognize the actions of any pedestrian who might enter the vehicle's path. Early recognition of individuals is similarly necessary in a variety of other situations, such as school-crossing guards, emergency service personnel, road and railway maintenance personnel, airport ground personnel, certain military personnel, etc. By definition, adequate conspicuousness provides this assurance of visibility.

Provision of adequate conspicuousness at night poses special problems because of natural and unavoidable changes in critical visual functions. As illumination decreases, the pupils dilate producing increased optical aberrations. At the same time, the eyes' automatic focusing process, call "ocular accommodation," loses its normal efficiency, giving rise to a common problem called night myopia. These optical changes, coupled with diminished activity of neural systems serving central vision, produce progressive losses of visual acuity and contrast sensitivity. Such losses are most severe for low-contrast stimuli. Even very large objects become invisible if their reflectance (brightness) is similar to that of their immediate surroundings. In effect, stimuli that are quite conspicuous in daylight are often naturally camouflaged in low illumination. In addition to problems of visual recognition, it becomes increasingly difficult to localize objects accurately in dim light. This occurs because most of the spatial information used in daylight, such as texture gradients, motion parallax, perspective, and shadows, is no longer available. At the same time, stereoscopic (binocular) depth perception, which depends on detection of small differences between the retinal images, is greatly reduced. These visual changes are responsible for errors of distance perception, which are also related to misperceptions of size, orientation, depth, and motion.

Because of these changes, a driver's visual capabilities are progressively handicapped as illumination drops through twilight to darkness. The rate and degree of visual disability varies somewhat from driver to driver in ways related to age, health, visual pathology, alertness, intoxication, etc. But for all drivers, there is serious visual impairment when driving in darkness.

Very few drivers appreciate their visual limitations at night and adjust their behavior accordingly. Although steering a vehicle along a well marked highway is as easy and efficient at night, the driver's ability to see, recognize and respond to unmarked and unexpected hazards is severely reduced. From the standpoint of behavioral science and safety engineering, the most effective method to combat inevitable losses of visual function at night is to assure that all potential obstacles and hazards are marked in such a way as to be visually conspicuous. By taking advantage of the perceptual sensitivity to "biological motion," the safety wear of this invention provides an effective and inexpensive means to provide optimal conspicuousness for any moving human or animal viewed at night.

Within the present state-of-the-art, a simple precaution by which individuals can increase their conspicuousness at night is to wear light colored

clothing. A white jacket is easier to see than a black one. Still better is to wear some type of retroreflective marking. With dark non-reflective clothing, a pedestrian is not visible to a driver until the auto approaches to distances of less than 100 feet. Such short visiability distances are not safe even for vehicles travelling as slow as 25 mph. White clothing can increase visibility of the pedestrian to distances of 200-300 feet, and retroreflective or luminous markings can be highly visible at much greater distances.

Therefore, some joggers wear a vest with a reflective square or stripe on the back and another one on the chest. Such vests are commonly available. When the beams from vehicle headlights (or any other directional light source) strike the retroreflective material, a driver readily detects a bright spot on or near the road ahead. Nevertheless, the form and movement of the individual who is wearing the reflective marking are not so readily recognized at night -- even with high-beam headlights because, in low ambient illumination, the driver is not likely to recognize what the bright spot is. As described in Allen (1970), drivers can identify a bright spot or patch of light incorrectly to be a highway delineator, sign, mailbox, or some other reflectorized object. Further, the driver might fail to perceive that the spot is moving until his or her vehicle is much closer to the pedestrian, particularly if the pedestrian is walking, jogging or running in the same general direction as the car. This is because the physical structure of available retroreflective markings does not represent the static or dynamic structure of the human body. Conventional state-of-the-art retroreflective markings lack the specific holistic structure that is provided by the configuration of the present invention and is essential if visible markings are to be recognized immediately as a human, or other living organism.

The use of particular signs or markings which specify symbolically the nature of a hazard, have been proposed as a means to improve pedestrian conspicuousness at night. This approach, which is used widely as a means of designating slow moving vehicles, has the disadvantage of requiring infallible associative learning and memory. Many drivers in the United States have learned that an orange reflective triangle means that a slow moving vehicle is ahead. While this type of symbolic marking can be helpful, it obviously requires educating the driving public to understand the meaning of a given symbol. Drivers who do not know, or momentarily forget, the meaning of the slow-moving-vehicle triangle will fail to appreciate the significance of the warning. Symbolic markings are not universally effective and, therefore, do not provide optimal protection for pedestrians and other highway users.

To improve nighttime safety of pedestrians, a variety of retroreflective configurations have been proposed and marketed. There are retroreflective shoes; headbands; belts; sweatsuits with retroreflective piping, etc. Also, various light producing devices have been suggested for pedestrians. All of these can provide earlier detection. However, for the reasons outlined, they do not assure immediate identification of the pedestrian as a human figure. This invention represents a new pattern that assures instant recognition of the human figure at the same moment of detection. This new configuration enhances significantly the pedestrian's nighttime conspicuousness and, therefore, will give drivers more time and greater distance to avoid mishap. This added time and distance will often mean the difference between life or death.

One object of this invention is to provide retroreflective or other light producing elements in locations on a pedestrian which enable a vehicle driver at night to immediately recognize a human form.

Another object of this invention is to provide instantaneous recognition, as opposed to simple detection, of a human at night, without the need for special training or education. As a result, the reaction time available to the driver to avoid an accident is increased.

A preferred embodiment of the invention provides safety wear adapted to be worn by a pedestrian at night to enable immediate recognition by the driver of an approaching vehicle without the need for special education or training of the driver, characterised in that the safety wear comprises light producing elements at a majority of the major joints of the wearer, said elements being subject to movement relative to each other responsive to the biological actions of the wearer, whether running, walking or the like, and means to apply such elements to the joint locations of the wearer. The term light producing elements as used herein is to be understood to include retroreflective elements, reflective elements and light source elements. Retroreflective elements are preferred.

The safety wear preferably comprises a suit with said light producing elements in the form of retroreflective bands surrounding a majority of the major joints of the wearer and which respond to the light beams of the vehicle, the pedestrian being visible regardless of the direction from which he or she is approached.

The retroreflective bands are conveniently attached to the suit by Velcro type elements, each joint having a part attached to the suit and a corresponding detachable retroreflective part to be added when the suit is to be worn after dark. The retroreflective elements are applied to the wrists, elbows, shoulders, hips, knees and ankles of the wearer.

A further embodiment of the invention also provides a method of enabling the driver of a vehicle when it is dark to recognize a pedestrian by providing such pedestrian with light producing elements at a majority of the major joints which move responsive to the biological motions of the wearer and display a pattern of light providing instant recognition.

The light producing elements are retroreflective and project light when contacted by the light beams of an approaching vehicle.

The method of the invention in its preferred embodiment provides light means to show biological motion to a car driver whereby a driver immediately knows that the object up ahead is a pedestrian and what that pedestrian is doing, such as jogging, walking or running.

Other objects of this invention will be evident hereinafter from the following description. While the invention is described in relation to an adult pedestrian, it might also be employed on animals, pets, children, cyclists, road and maintenance repair workers, firefighters, police officers, hunters and others. Further, although retroreflective material is preferred, simple reflective elements might also be used or light sources worn by the pedestrian. The innovation here is the configuration of markings to create perceptual advantages applicable to biological motion.

In the drawings:

Figure 1 shows a person in a sweatsuit having retroreflective, reflective or light elements applied thereto; and

Figure 2 shows that person running in the dark with the elements being visible and indicating the biological motions of the wearer.

Referring now to the drawings by numerals of reference, 10 is a person wearing a sweatsuit having a top 12 and a bottom 14. The top has a body portion 16, sleeves 18 and 20, a band 22 around waist or hips of the person and cuffs 24 and 26 around the wrists of the wearer.

The bottom 14 of the sweatsuit has legs 30 and 32 provided with cuffs 34 and 36 around the ankles of the wearer.

To enable the pedestrian to be conspicuous at night, particularly by the light beams from a car, retroreflective bands or elements are provided at a majority of and preferably at all of the major bodily joints of the person. These elements may also be reflective or light source elements. This includes an element which goes all the way around the body of the wearer on the band 22 and elements on the cuffs 24 and 26 which surround the wearer's wrists. In addition, there are retroreflective bands 40 and 42 around the sleeves of the suit at the wearer's elbows and similar bands 44 and 46 around the shoulders at the joints with the arms of the person.

The lower half of the sweatsuit has retroreflective bands or elements on the cuffs 34 and 36 which surround the ankles of the wearer. Similar bands 50 and 52 are provided around the legs of the sweatsuit to encircle the wearer's knees, as shown.

These bands can be of any common retroreflective material sewn in place on the garment when it is manufactured. Or, the suit can be provided with Velcro elements sewn to the suit and adapted to receive corresponding Velcro backed retroreflective strips attachable to the elements. Reflective and/or light elements can be similarly applied.

In place of continuous strips, a series of dots and retroreflective elements could be employed on each band and sufficient in number to enable the person to be seen regardless of the direction from which the pedestrian is approached by a vehicle.

Figure 2 shows the person in motion in the dark. When a driver sees this grouping of light elements, it becomes immediately evident that what is seen is a running person. The location of the various retroreflectors at the person's joints responding to the lightbeams of the car, and the relation of these points to each other, provides an instantaneous recognition factor.

In like respect, if a person with this suit is walking, jumping, climbing a ladder, riding a bicycle or other activity, the driver will become immediately aware of the pedestrian up ahead and what the individual is doing. No training or education of drivers is involved to achieve this recognition. Different observers from all sorts of backgrounds on seeing such a collection of light reflections, and the biological movements of reflective elements relative to each other, will immediately know what is ahead. The recognition factor is universal. In some circumstances, the gender of the wearer even becomes evident.

Therefore, when a pedestrian is on a roadway after dark and a vehicle approaches with its lights on, the beams reflect off the moving retroreflective elements on the sweatshirt. Unlike prior retroreflective or reflective means which only tells the driver the car is approaching something, the biological movements of this invention inform the driver that it is a person and further what that person is doing.

If similar reflective elements were applied around the joints of a dog, for example, the driver would recognize that what is seen is a dog, not a person.

A major advantage of this invention is that no driver training is needed. Identification occurs at first sight. This increases the time available for the driver to react and avoid an accident, for if the driver knows that a pedestrian is out front, greater precautionary measures will be taken. The driver

does not mistake the pedestrian for some type of marker. What the driver receives is recognition much earlier than when the pedestrian is merely wearing conventional, retroreflective or reflective means not located at the major joints.

Claims

1. Safety wear adapted to be worn by a pedestrian (10) at night to enable immediate recognition by the driver of an approaching vehicle without the need for special education or training of the driver, characterised in that the safety wear comprises light producing elements (22, 24, 26, 40, 42, 44, 46, 34, 36, 50, 52) at a majority of the major joints of the wearer, said elements being subject to movement relative to each other responsive to the biological actions of the wearer, whether running, walking or the like, and means to apply such elements to the joint locations of the wearer.

2. Safety wear according to Claim 1 characterised in that the light producing elements 22, 24, 226, 40, 42, 44, 46, 34, 36, 50, 52) are retroreflective.

3. Safety wear according to Claim 1 or 2 which comprises a suit with said light producing elements (22, 24, 26, 40, 42, 44, 46, 34, 36, 50, 52) in the form of retroreflective bands surrounding a majority of the major joints of the wearer and which respond to the light beams of the vehicle, the pedestrian being visible regardless of the direction from which he or she is approached.

4. Safety wear according to claim 3 wherein the retroreflective bands (22, 24, 26, 40, 42, 44, 46, 34, 36, 50, 52) are attached to the suit by Velcro type elements, each joint having a part attached to the suit and a corresponding detachable retroreflective part to be added when the suit is to be worn after dark.

5. Safety wear according to any of the previous claims wherein the retroreflective elements (22, 24, 26, 40, 42, 44, 46, 34, 36, 50, 52) are applied to the wrists, elbow, shoulders, hips, knees and ankles of the wearer.

6. A method of enabling the driver of a vehicle when it is dark to recognize a pedestrian (10) by providing such pedestrian (10) with light producing elements (22, 24, 26, 40, 42, 44, 46, 34, 36, 50, 52) at a majority of the major joints which move responsive to the biological motions of the wearer and display a pattern of light providing instant recognition.

7. A method according to claim 6 wherein said light producing elements (22, 24, 26, 40, 42, 44, 46, 34, 36, 50, 52)are retroreflective and project light when contacted by the light beams of an approaching vehicle.

EP 0 383 478 A1

Fig. 1

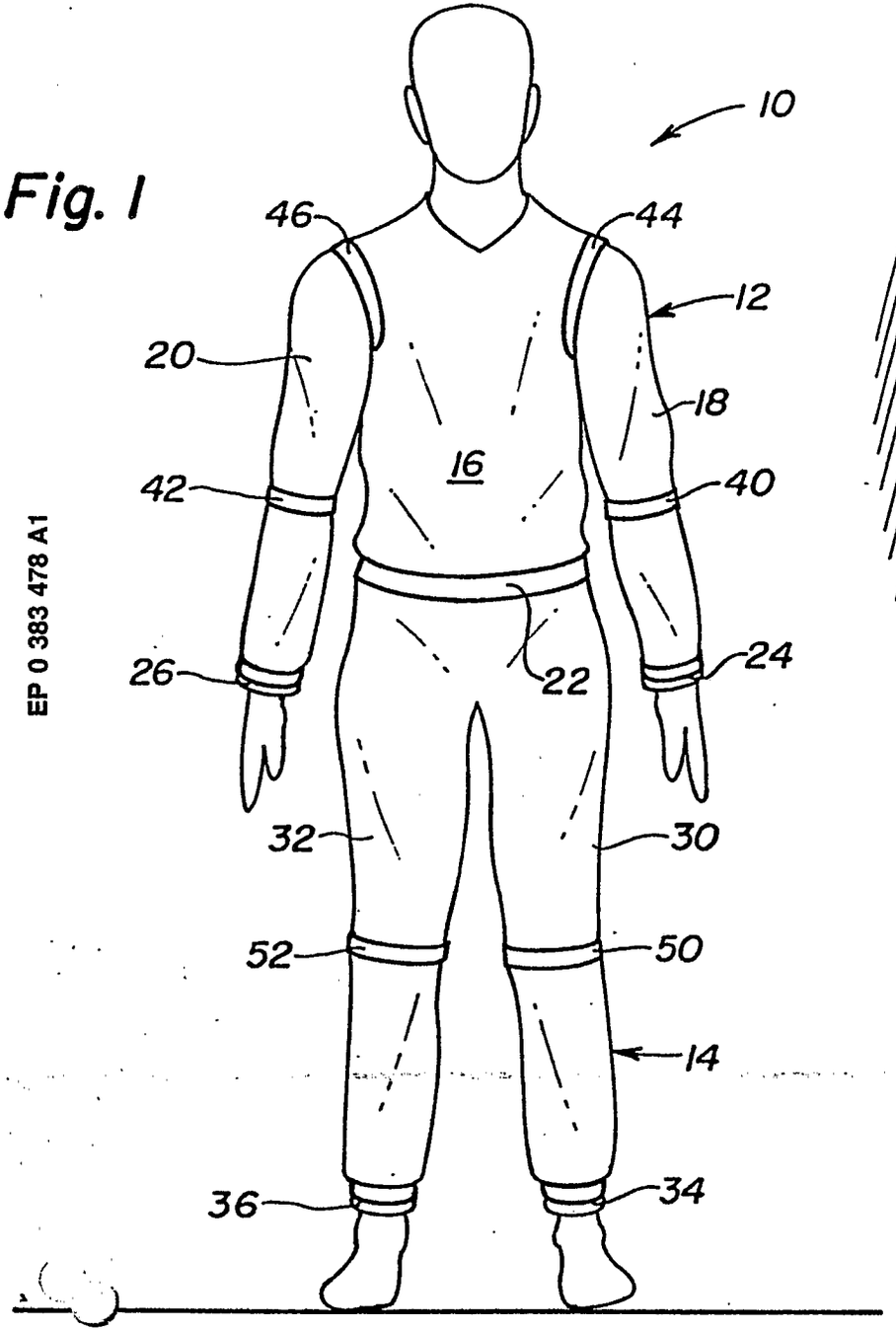
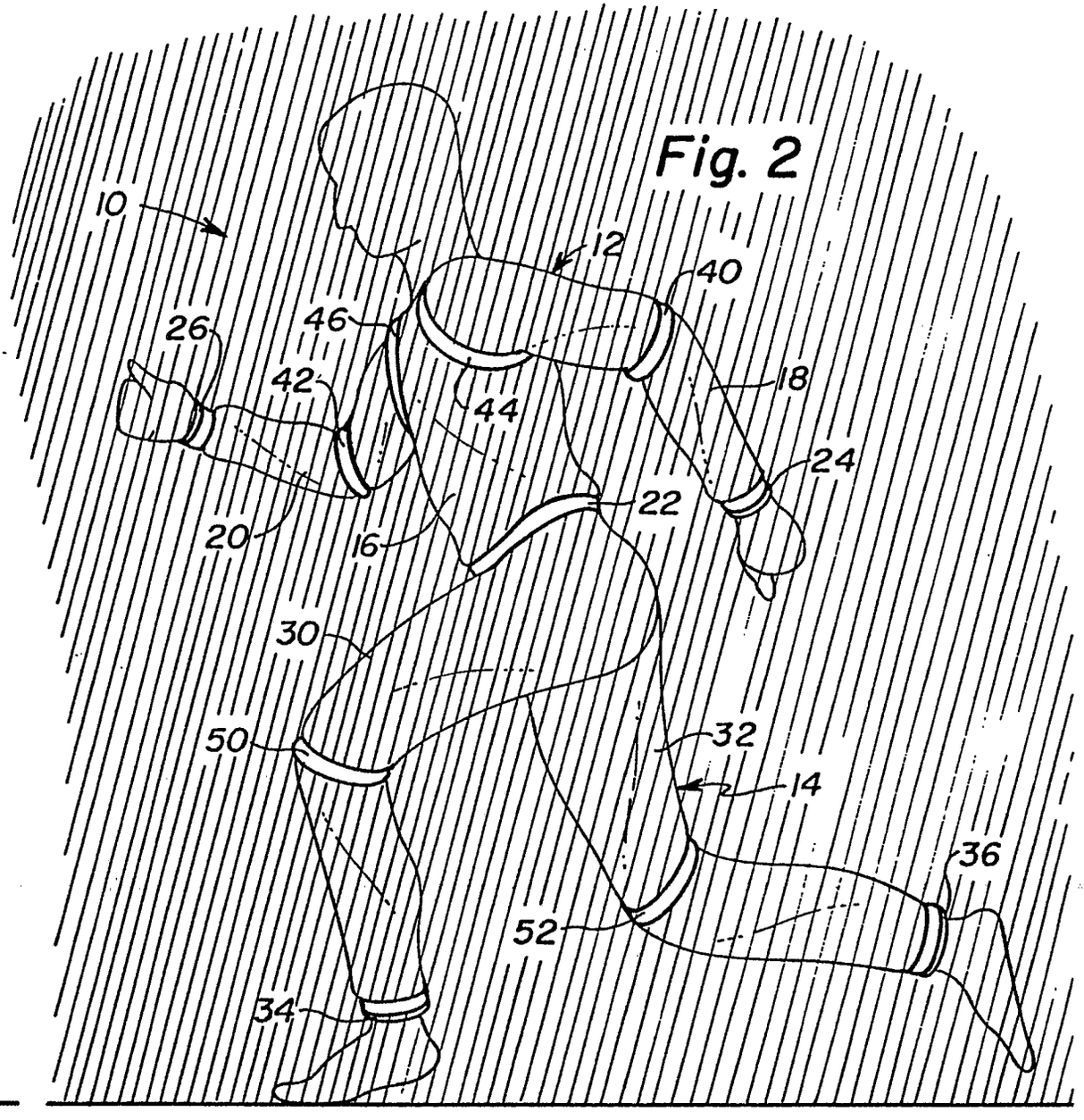


Fig. 2



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EUROPEAN SEARCH REPORT

Application Number

EP 90 30 1299

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0276498 (KRAAIJER NEDERLAND) * column 3, line 24 - column 5, line 31; figures 1-7 *	1-3, 5-7	A41D13/00 G08B5/00
X	FR-A-1034830 (CH. MONNET) * the whole document *	1-3, 6, 7	
X	DE-U-8716942 (K. PAWLOWSKI) * the whole document *	1, 2, 4, 6, 7	
X	FR-A-2169731 (CH. LOEWE) * claims 1-9 *	1-3, 5-7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A41D
G08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01 JUNE 1990	GARNIER F.M.A.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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