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(54) **Method and system for extinguishing fires in tunnels**

(57) A method and system for extinguishing fires in road or railway tunnels, in which a plurality of smoke and/or heat sensor devices are distributed in successive regions of the tunnel, each sensor being connected to and controlling a pumping system which feeds water to independent separate stations in which water and foaming liquid are mixed to form a fire-extinguishing foaming mixture used to feed under pressure a plurality of deliv-

ery nozzles located only in that tunnel region in which the smoke and/or heat has been sensed, in each of said regions the nozzles being provided on both sides of the tunnel and being distributed on each side at two different levels to direct the jets of mixture mainly towards the floor and onto the lower part of the tunnel and, respectively, towards the floor and the opposite wall of said tunnel.

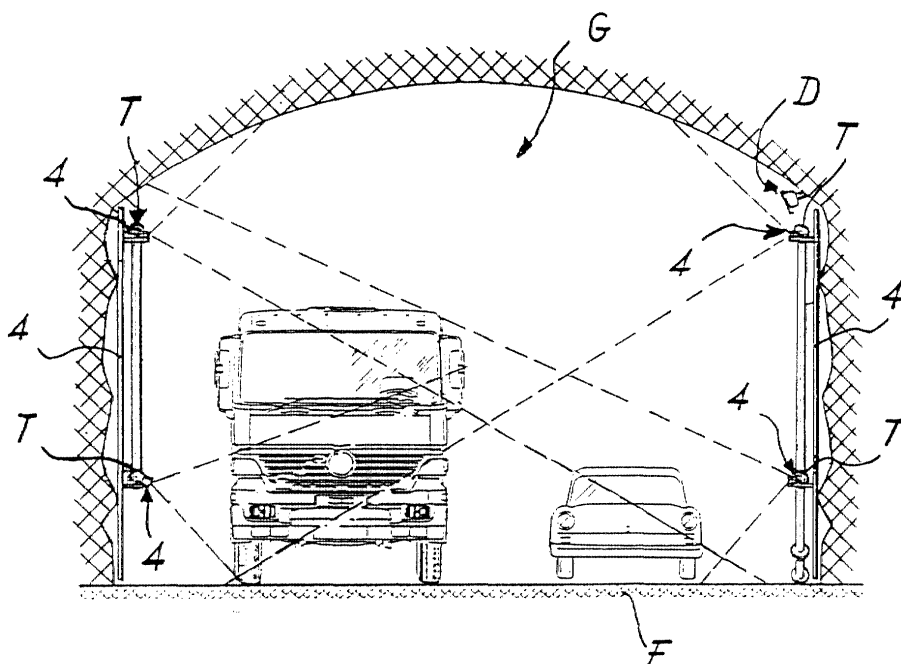


FIG. 2

Description

[0001] This invention relates to a method and system for extinguishing fires in road or railway tunnels.

[0002] Fires in road and railway tunnels often involve very serious problems and consequences, especially if the tunnel is very long (some exceed more than 10 km). Although the actual fire may involve a tunnel region of very short length, the toxic fumes which develop from the fire can fill very lengthy sections of the tunnel within a very short time, to emerge from one of its ends.

[0003] Sensor devices for smoke and/or heat (developed by the fire) can be positioned along tunnels to emit a signal which is fed to a control centre in order to cause a mixture of water and foaming liquid to be pressure fed - automatically or manually by an operator - to a plurality of distributor nozzles along the tunnel.

[0004] With the usual method, all the nozzles provided along the tunnel or along very long sections of it are fed simultaneously with the pressurized mixture. This presents problems determined by the fact that the pipes and the mixture pumping stations must be of very large size (as the mixture is delivered simultaneously by a large number of nozzles), the fact that there is necessarily a dangerously long time interval between the moment in which the presence of smoke or heat is detected and the moment in which the fire extinguishing liquid is sprayed into the tunnel (for the aforesaid reasons), and the fact that the fire extinguishing foam mixture is also sprayed into tunnel regions where it is not required and where in fact it can create serious problems or danger (in that an automobile passing through a tunnel region far from the fire can suddenly find itself at the centre of violent jets of foam mixture).

[0005] To prevent this, delivery nozzles have been mounted on pipes in which the pressurized mixture is always present, these nozzles being closed by elements which melt or rupture when exposed to the heat of a fire, to hence allow free mixture outflow through the nozzle.

[0006] This system also has drawbacks in that only those heat-sensitive elements directly exposed to the heat are ruptured, and not those adjacent to them, where their intervention could be useful or providential by virtue of their location in a region in which the fire has not yet started but in which as yet unignited fuel may be present.

[0007] In all cases, in the known art the delivery nozzles for the pressurized fire-extinguishing mixture are positioned on the tunnel ceiling. The toxic fumes developed by the fire tend to distribute along the tunnel ceiling, hence they are violently entrained by the jets of fire-extinguishing foam towards the floor (where persons may be present), so aggravating the consequences of the fire.

[0008] The main object of this invention is to provide a method and system for extinguishing fires in road and railway tunnels, by which fire-extinguishing foam can be rapidly fed to only those nozzles located at and in prox-

imity to a fire, and which enable the jets of this foam to be directed onto the floor and onto the lower parts of the tunnel from both its sides, and such that the fumes collecting on the tunnel ceiling are subjected to little or no turbulence.

[0009] These and further objects are attained by a method by which the presence of smoke and/or heat is sensed at a plurality of points distributed within successive regions of the tunnel, each positive sensing in any individual region of the tunnel activating a pumping system which feeds water to independent separate stations in which water and foaming liquid are mixed to form a fire-extinguishing foaming mixture used to feed under pressure all those mixture delivery nozzles located in that, and only that, tunnel region in which the presence of heat and/or smoke has been sensed, the fire-extinguishing mixture being sprayed into that tunnel region simultaneously at two levels from both sides of the tunnel such that the mixture sprayed at the lower level is directed mainly towards the floor and partly towards the central part of the tunnel, whereas the mixture sprayed at the higher level is directed partly towards the floor but mainly towards the central part of the tunnel.

[0010] The method is implemented by a system comprising a plurality of smoke and/or heat sensing devices distributed within successive regions of a tunnel along which a plurality of delivery nozzles are distributed on both sides of the tunnel at at least two separate levels from the floor, and are orientated in such a manner as to direct the liquid jets delivered by them towards the tunnel floor and towards that tunnel side opposite the side on which the considered nozzles are located, the nozzles being divided into independent separate groups of connected-together nozzles which are positioned in successive tunnel regions and are independently connected to a pumping system which feeds water to independent separate stations in which water and foaming liquid are mixed to form a fire-extinguishing foaming mixture used to feed under pressure the nozzles of that plurality of nozzles the operation of which has been triggered by that smoke and/or heat sensor or group of sensors located in the actual tunnel region into which the mixture is sprayed by the nozzles provided in that region.

[0011] The tunnel fire-extinguishing system will be more apparent from the ensuing description of one embodiment thereof, given by way of non-limiting example with reference to the accompanying drawings, on which:

Figure 1 is a schematic representation of a fire-extinguishing system for tunnels;

Figure 2 is a cross-section through a tunnel provided with the fire-extinguishing system; and

Figure 3 is a partial front view of a portion of the fire-extinguishing system as it appears on one side of the tunnel.

[0012] Reference will firstly be made to Figure 1 which

shows a sectional plan view of a tunnel G, the length of which is imagined to be divided into successive regions Z1, Z2, Z3, ... Zn.

[0013] In each of these regions there are provided, on both sides of the tunnel G, a plurality of delivery nozzles indicated by the letters U1, U2, U3, ... Un, the nozzles present in each tunnel region forming groups which are separate and independent of the nozzle groups present in the other regions.

[0014] Each group of nozzles U1, U2, U3 ... Un is connected by separate pipes T1, T2, T3, ... Tn to a separate valve V1, V2, V3 ... Vn connected in its turn by a pipe 3 to a mixer M in which a foam forming liquid contained in a tank S is mixed with water originating from a water reservoir R and fed via a pipe 1 to a pump P which feeds the water under pressure to the mixer M via a delivery pipe 2.

[0015] In each region Z1 ... Zn of the tunnel there are provided one or more smoke and/or heat sensors, shown schematically on the drawing by a succession of dots and indicated by the reference numerals D1, D2, D3, ... Dn.

[0016] Each of the sensing systems D1 ... Dn is connected (by separate lines shown dashed and without reference numerals for simplicity) to a control board C which feeds signals via separate electrical lines C1, C2, C3 ... Cn to open or close that or those valves V1 ... Vn associated with that sensing system D1 ... Dn which has sensed the presence of smoke and/or fire.

[0017] In this manner, the mixture of water and fire-extinguishing foaming liquid is fed only to those groups of nozzles U1 ... Un located in the region in which the presence of smoke and/or heat deriving from a fire has been sensed.

[0018] As stated, the nozzles are provided on both walls of the tunnel. They are distributed at two different levels from the tunnel floor F. Figure 3 schematically shows a portion of one side of a tunnel in which it can be seen that uprights 4 support (on each side of the tunnel) two parallel pipes (both connected to the initially mentioned same valve V1 ... Vn) which carry the nozzles U.

[0019] Those nozzles positioned at the lower level direct the jet of fire-extinguishing liquid delivered by them (when fed with this liquid) mainly onto the tunnel floor F (immediately below the considered nozzle) and partly towards the centre of the tunnel.

[0020] Those nozzles U positioned at the higher level direct their jet of fire-extinguishing liquid mainly towards the centre of the tunnel and partly towards the tunnel floor F but in proximity to the opposite wall of the tunnel. The nozzle distribution is clearly visible in Figure 2, in which the jets of fire-extinguishing liquid are shown schematically by dashed lines diverging as a cone from each nozzle.

[0021] Figure 2 also shows the devices D for sensing the smoke and/or heat developed by a possible fire.

[0022] In practice, each of the tunnel regions Z1 ... Zn

can have a length for example of about 100-150 m; those nozzles positioned at the lower level can be at about 1.0-1.2 m from the floor and those at the higher level at about 4 m from the floor, the distance between one nozzle and the next at the same level being about 3 m.

[0023] Those jets of fire-extinguishing mixture delivered by the nozzles positioned at the lower level protect the floor, where as yet unignited combustible liquid (petrol, etc.) may be present, and also protect the lower parts (engine, brakes, transmission etc.) of vehicles present in that tunnel region in which the fire-extinguishing system has operated.

[0024] Those jets of mixture delivered by the nozzles positioned at the higher level protect the higher parts of goods vehicles and the goods carried by them.

[0025] As the nozzles are of the always open type, as already stated, and as the entire fire-extinguishing system is divided into a plurality of separate sectors fed independently, delivery of the fire-extinguishing mixture can be achieved in a very short time, without having to use pipes of large diameter and oversized pumps. Moreover any fumes which collect along the tunnel ceiling are not struck by the jets of fire-extinguishing mixture and are not forced downwards where they could be very dangerous for persons present in that tunnel region considered.

[0026] The fire-extinguishing foaming liquid used can be any of those in common current use, such as synthetic film-forming or protein liquids of the aqueous film forming foam (AFFF) or film forming fluoro protein (FFFP) type, or simple synthetic foams.

Claims

1. A method for extinguishing fires in road or railway tunnels, by which the presence of smoke and/or heat is sensed at a plurality of points distributed within successive regions of the tunnel, each positive sensing in any individual region of the tunnel activating a pumping system which feeds water to independent separate stations in which water and foaming liquid are mixed to form a fire-extinguishing foaming mixture used to feed under pressure all those mixture delivery nozzles located in that, and only that, tunnel region in which the presence of heat and/or smoke has been sensed, the fire-extinguishing mixture being sprayed into that tunnel region simultaneously at two levels from both sides of the tunnel such that the mixture sprayed at the lower level is directed mainly towards the floor and partly towards the central part of the tunnel, whereas the mixture sprayed at the higher level is directed partly towards the floor but mainly towards the central part of the tunnel.
2. A system for extinguishing fires in road or railway

tunnels, comprising a plurality of smoke and/or heat sensing devices distributed within successive regions of a tunnel along which a plurality of delivery nozzles are distributed on both sides of the tunnel at at least two separate levels from the floor, and are orientated in such a manner as to direct the liquid jets delivered by them towards the tunnel floor and towards that tunnel side opposite the side on which the considered nozzles are located, the nozzles being divided into independent separate groups of connected-together nozzles which are positioned in successive tunnel regions and are independently connected to a pumping system which feeds water to independent separate stations in which water and foaming liquid are mixed to form a fire-extinguishing foaming mixture used to feed under pressure the nozzles of that plurality of nozzles the operation of which has been triggered by that smoke and/or heat sensor or group of sensors located in the actual tunnel region into which the mixture is sprayed by the nozzles provided in that region.

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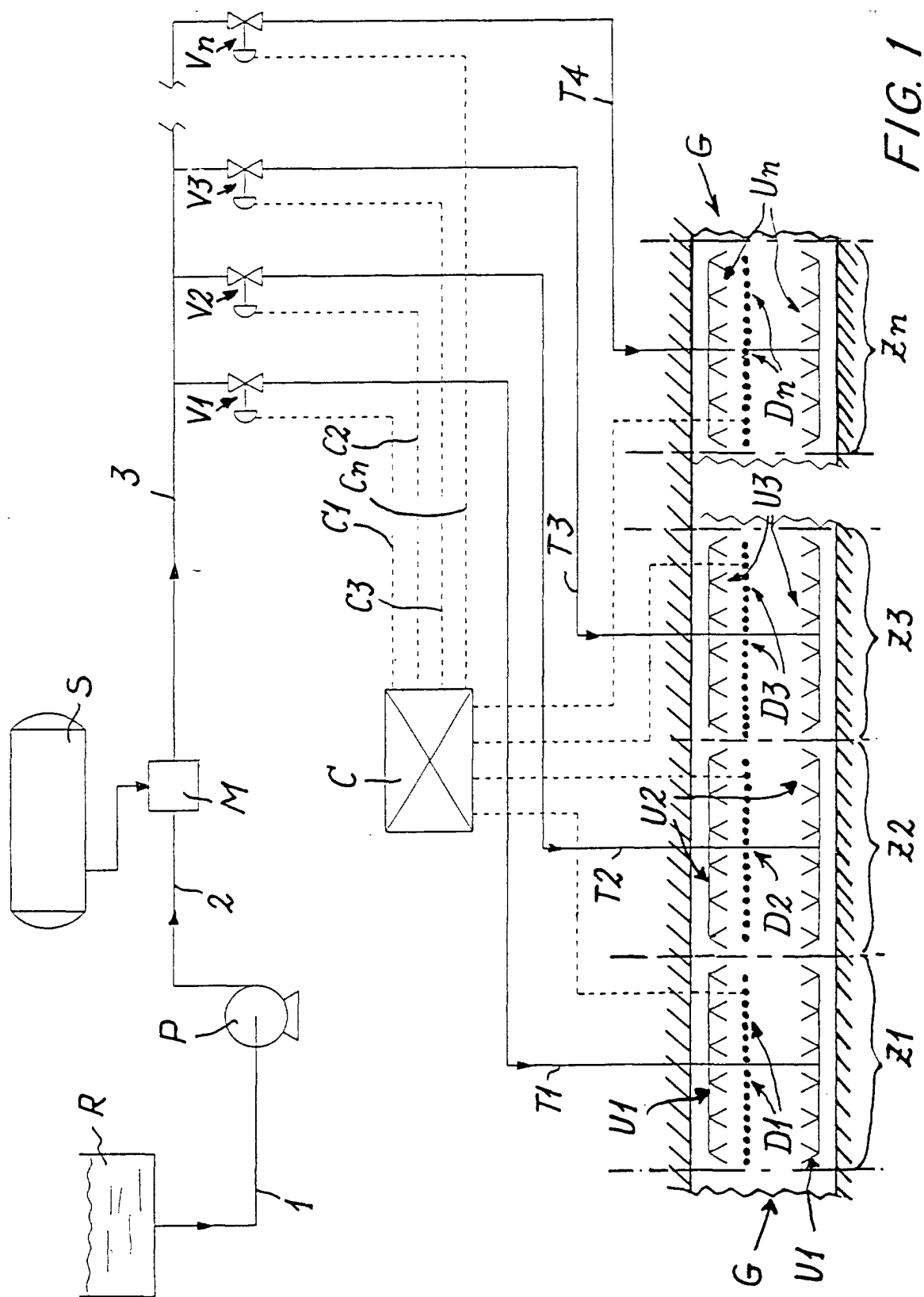
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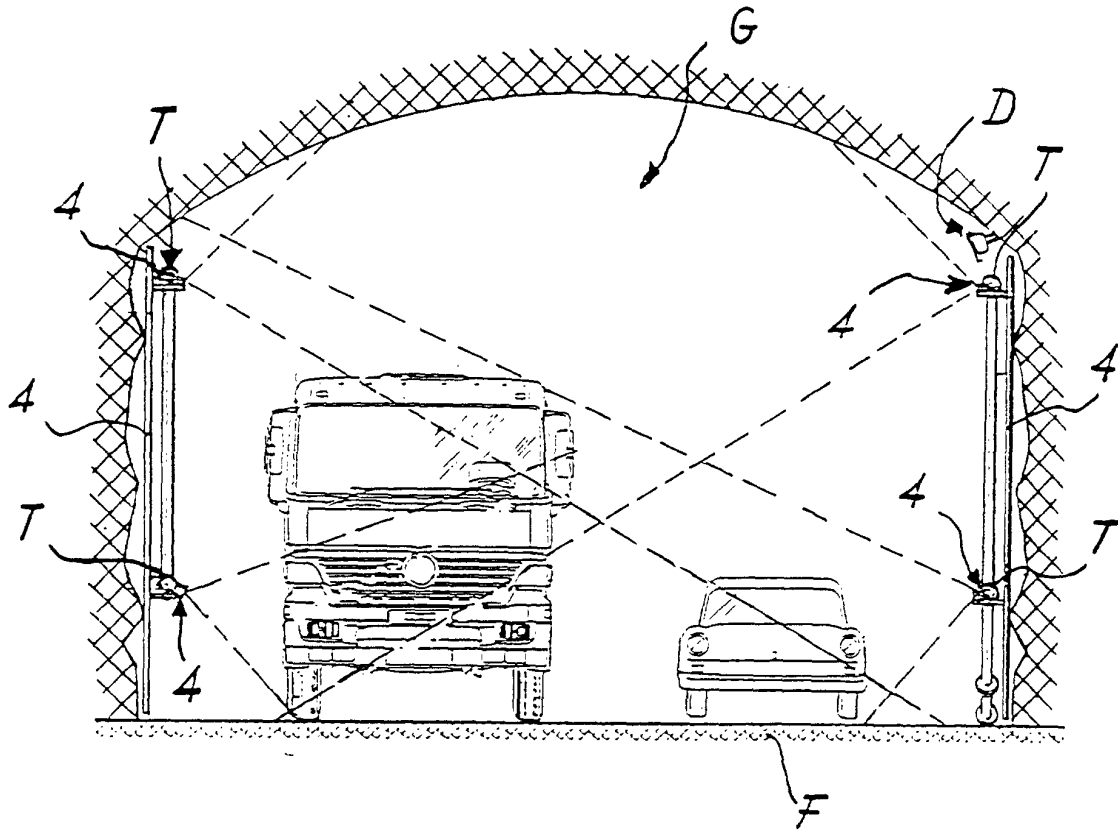


FIG. 2

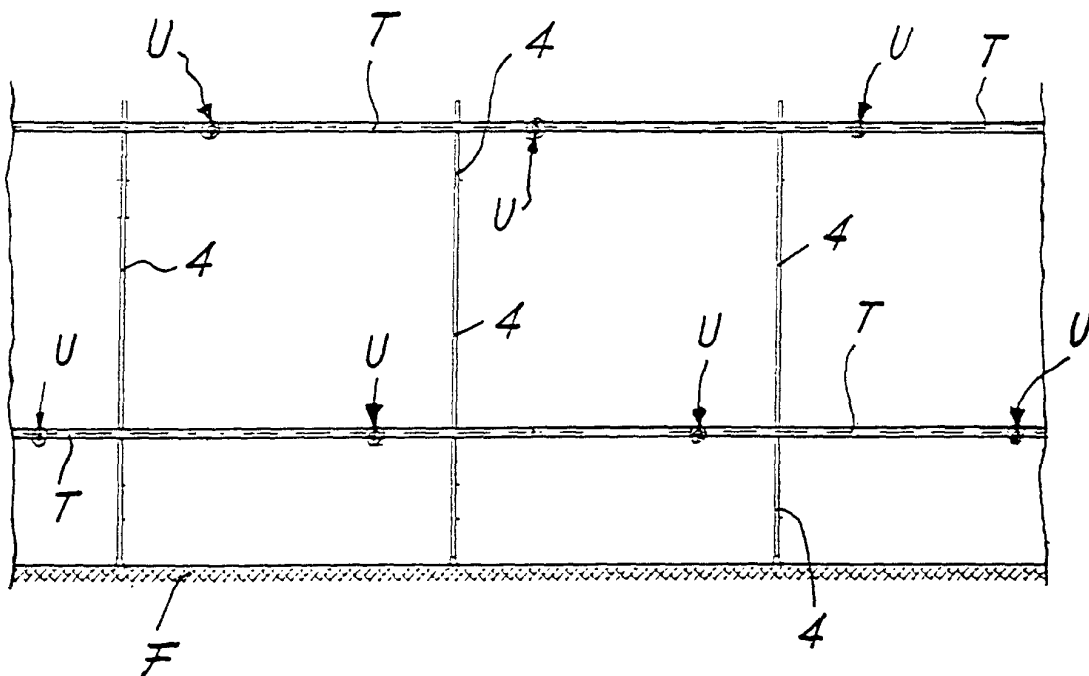


FIG. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 0832

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CI.7)
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 606 (C-1128), 8 November 1993 (1993-11-08) & JP 05 184693 A (NOHMI BOSAI LTD), 27 July 1993 (1993-07-27) * abstract *	1,2	A62C3/02
A	DE 299 11 569 U (HECK JUERGEN) 30 September 1999 (1999-09-30) * the whole document *	1,2	
			TECHNICAL FIELDS SEARCHED (Int.CI.7)
			A62C E21F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		8 October 2001	Neiller, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 12 0832

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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08-10-2001

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
JP 05184693	A	27-07-1993	JP	3054974 B2	19-06-2000
DE 29911569	U	30-09-1999	DE	29911569 U1	30-09-1999