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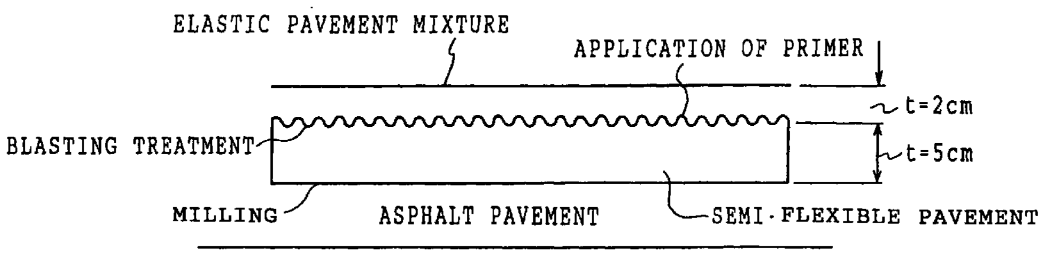
(54) Reduced noise elastic pavement material and method of application thereof

(57) The present invention is a reduced noise elastic pavement material which is applied to roadways and has a noise reducing effect and a vibration reducing effect due to elasticity, air permeability, and sound absorption. The reduced noise elastic pavement material has a structure in which a hard aggregate and an elastic aggregate are bonded together by a urethane binder. More specifically, the reduced noise elastic pavement material is formed by a hard aggregate, an elastic aggregate, and a urethane binder which bonds the hard aggregate and the elastic aggregate together, in which the hard aggregate is 10 to 75 % by volume of a total volume of the hard aggregate and the elastic aggregate, and a two-component urethane binder is used as the urethane binder.

FIG. 2



EP 1 052 333 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a pavement which is applied to roadways and has a noise reduction effect and a vibration reducing effect due to the elasticity, air permeability, and sound absorption thereof. Further, the present invention relates to a reduced noise elastic pavement material which has a structure in which a hard aggregate and an elastic aggregate are bonded together by a urethane binder, and to a method of applying the reduced noise elastic pavement material.

Description of the Related Art

[0002] Conventionally, a pavement material formed by bonding rubber chips together by a binder has high elasticity and has been mainly used for sidewalks and sport stadiums from the aspects of impact absorption when a person walks thereon and safety when the person stumbles. On the other hand, an example of a pavement material for roadways which results in less noise is a water draining pavement. It is known that a tire noise is reduced by air permeability and sound absorption due to voids formed at the drain pavement.

[0003] However, in the case of using a pavement material formed by bonding rubber chips together by a binder, the amount of flexure with respect to a load is so large that problems arise with respect to the driving stability of a vehicle when the pavement material is applied to roadways. Further, a tire is apt to slip when the pavement material is wet. Moreover, because of its low strength, it is difficult to utilize the pavement material formed by bonding rubber chips together by a binder for roadways.

[0004] On the other hand, a drain pavement generally has a noise reducing effect which allows a reduction in noise of about 3 dB. This reduction in noise is due to the reduction in tire noise resulting from air permeability and sound absorption due to the voids formed at the drain pavement. However, it is difficult to obtain an even greater noise reducing effect.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide a reduced noise elastic pavement material which is formed by bonding a hard aggregate and an elastic aggregate together by a urethane binder, and in which less noise effect due to elasticity, air permeability, and sound absorption and a reduction in vibration due to elasticity can be obtained, and to a method of applying the pavement material.

[0006] In accordance with a first aspect of the present invention, there is provided a reduced noise elastic pavement material which includes a hard aggregate, an elastic aggregate, and a urethane binder which bonds the hard aggregate and the elastic aggregate together, wherein the hard aggregate is 10 to 75 % by volume of the total volume of the hard aggregate and the elastic aggregate, and a two-component urethane binder is used as the urethane binder. In accordance with a second aspect of the present invention, there is provided an applying method of reduced noise elastic pavement material, including the steps of; carrying out a milling step and/or a blast cleaning step by a shot-blasting on a road surface; applying a primer to the road surface; mixing a hard aggregate, an elastic aggregate, a urethane binder, or the like by using a mixer to prepare a mixture; applying the mixture to the road surface; and compacting the mixture, wherein the hard aggregate is 10 to 75 % by volume of the total volume of the hard aggregate and the elastic aggregate, and a two-component urethane binder is used for the urethane binder.

[0007] According to the present invention, a rubber chip material having a diameter of 10 mm or less is preferably used for the elastic aggregate and colored rubber chips are used for a portion of or entire elastic aggregate. On the other hand, the hard aggregate is preferably used, which includes at least 5 % by weight of a component which passes through a sieve opening of 1.18 mm.

[0008] A two-component urethane binder is used as the binder and is formed by an isocyanate group terminated prepolymer and a polyol. An organic silane is preferably added to the urethane binder in an amount of 0.1 to 5 % by weight based on the weight of the urethane binder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a flow chart of processes involved in applying a reduced noise elastic pavement material of the present invention.

Fig. 2 is a cross-sectional structure of a pavement application example case 1.

Fig. 3 is a cross-sectional structure of a pavement application example case 2.

Fig. 4 is a cross-sectional structure of a pavement application example case 3.

Fig. 5 is a cross-sectional structure of a pavement application example case 4.

Fig. 6 is a graph showing a relationship between the content (% by volume) of a hard aggregate in the total amount of aggregates, skid resistance (BPN), and a noise reduction performance (dB).

Fig. 7 is a graph showing a relationship between the amount (% by weight) of the hard aggregate which passes through a sieve opening of 1.18 mm and the skid resistance.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Embodiments of the present invention will be described mainly with respect to a first aspect of the present invention. Generation of tire noise from a road surface is caused by vibration which is generated by the contact between a tire tread and the road surface. Main sources of noise are the noise generated by the vibration of a tread pattern or a sidewall, and the noise generated by resonance of sound produced by the road surface and grooves such as rib grooves, lug grooves, or the like.

[0011] However, in the case in which there are voids at the road surface, for example, in the case of a drain pavement, resonance within the grooves is hardly generated, such that noise itself is also hardly generated, and further, the noise is reduced by sound absorption by the drain pavement.

[0012] In the pavement material of the present invention, the vibration is interfered with by providing the pavement material with superior elasticity so as to reduce the noise which is caused by the vibration of the tread pattern or the sidewall. Further, the same noise reducing effect as that of a drain pavement material, which is caused by the voids, can be expected.

[0013] With regard to elasticity, a pavement material formed by bonding rubber chips together by a binder has superior elasticity and has a high noise reducing effect because of the voids formed therein. However, the amount of flexure with respect to a load is large. For example, when the pavement material is used for roadways, the turning response of a vehicle at the time of steering is delayed due to the flexure of the road surface, such that the driving stability of the vehicle significantly deteriorates. Further, the skid resistance of a vehicle on this pavement when the pavement is wet is lower than that on an ordinary road surface. Moreover, the strength of the pavement material is not sufficient.

[0014] The skid resistance depends on the amount of the hard aggregate. In order to ensure a skid resistance of 60 BPN or greater (which is measured by using a portable skid resistance tester), the amount of the hard aggregate must be 10 % or more of the total amount of the aggregate (see Fig. 6). If the proportion of the hard aggregate is small, the driving stability is affected not only by the skid resistance but also by an increase in the amount of flexure due to the weight of the vehicle. If the amount of the hard aggregate is too large, elasticity deteriorates such that effect of resulting in less noise is adversely affected (see Fig. 6). Accordingly, the hard aggregate is 10 to 75 % (volume ratio), preferably 50 to 75% (volume ratio) of the total amount of the aggregate. As illustrated in Fig. 7 (skid resistance measured by using a DF tester), the grain size of the hard aggregate is desirably such that 5 % or more (weight ratio) of the hard aggregate is fine grain components which pass through a sieve opening of 1.18 mm. The surface of the fine grain components is rough like sandpaper to provide an anti-skid effect.

[0015] The hard aggregate generally includes, but is not limited to including, a natural aggregate such as river gravel, river sand or the like and a synthetic aggregate such as crushed stone, slag, ceramics or the like. Stone, sand or the like is used in the hard aggregate in order to ensure the strength of the pavement material and the wear resistance thereof. Further, stone, sand or the like which is used in the hard aggregate is exposed on the surface of the pavement material so as to provide the anti-skid effect. From the viewpoint of skid resistance, the grain size of the hard aggregate is desirably such that the hard aggregate includes 5 % or more (weight ratio) of fine grain components which pass through a sieve opening of 1.18 mm. The surface of the fine grain components is rough like sandpaper to provide the anti-skid effect.

[0016] Rubber chips, i.e., small pieces of rubber or a powder of rubber, are used to provide the pavement with elasticity. Rubber chips having a grain diameter of from 1 mm or less to around 10 mm are suitable. Rubber chips having a grain diameter of 1 to 5 mm are preferable because they are effective in providing elasticity and forming voids. The rubber chips may be made of natural rubber or of a synthetic rubber. Further, rubber chips, which are made by mechanically grinding a vulcanized rubber product such as discarded tires or the like, may be used.

[0017] Here, the hardness in the present invention means the JIS • A hardness. The hard aggregate means an aggregate having a hardness of 95 degrees or more. The elastic aggregate refers to an aggregate having a hardness of 90 degrees or lower. The rubber chips in the example which will be described later have a hardness of about 65 degrees. The hardness of a discarded tire is generally 60 to 70 degrees, and the hardness of a discarded tire to which heat is applied is about 80 to 90 degrees.

[0018] A urethane binder is used to bond the aggregates so as to form the pavement material. It is preferable to use a two-component urethane binder which is prepared by mixing an isocyanate group terminated prepolymer with a polyol with an equivalent ratio of the hydroxyl groups to the isocyanate groups being, for example, 0.2 to 0.8. For example, the isocyanate group terminated prepolymer is such that the isocyanate content is 5 to 25 %, the viscosity is 1000 to 5000 CP (25°C), and the average number of functional groups of the isocyanate group terminated prepolymer is 2 to 3. Examples of the isocyanate for the prepolymer include, for example, a diphenylmethane diisocyanate-based polyisocyanate. Polyalkylene glycol having a molecular weight of 1000 to 3000 is usually used as an active hydrogen compound used for modification.

[0019] On the other hand, a preferable polyol has an average number of functional groups of 2 to 6, and an average molecular weight of 1000 or less. Further, one-half of or more than one-half of the hydroxyl groups of the polyol are preferably primary hydroxyl groups in view of the reactivity thereof Examples of the polyol include ethylene glycol, diethylene glycol, polyalkylene ether glycol, or the like.

[0020] Because the hardening time is determined mostly by the temperature at the time of laying the pavement material and the period of time until traffic is allowed thereon, it is possible to adjust the hardening time by adjusting the mixing ratio of the isocyanate group terminated prepolymer to the polyol. For example, the mixing ratio can be appropriately selected from the range of 0.2 to 1.0 of the equivalent ratio of the hydroxyl groups/the isocyanate groups. Although use of a one-component urethane binder may be considered, it is difficult to adjust the hardening time, and further, one-component urethane binders are not widely used. As compared with the case of using a one-component urethane binder, in the case of using a two-component urethane binder, it is easy to adjust the hardening time and is generally possible to reduce the hardening time. Accordingly, it is stipulated in the present invention that a two-component urethane binder must be used. It is also possible to adjust the hardening speed by using a known hardening accelerating agent such as an amine-based or a metallic-based hardening accelerating agent. It is desirable that the binder is included in an amount of 15 to 30 % by volume of the total amount of the pavement material from the viewpoint of the bonding strength of the aggregates.

[0021] By adding 0.1 to 10 % by weight of an organic silane into the urethane binder, the bonding strength between the urethane binder and the aggregates can be increased and improvements in the strength and the durability of the pavement material can be achieved. Examples of the organic silane include an epoxy-based or a mercapto-based organic silane.

[0022] Further, if the pavement material must be colored, coloring can be effected by mixing a coloring agent with the urethane binder. In this case, it is preferable that an amount of coloring agent which is 1 to 10 % by weight of the urethane binder is used. Examples of the coloring agent include carbon-based coloring agents when a black color is desired and titanium-based coloring agents when a white color is desired. The pavement material can also be colored by using colored rubber chips, for example, colored rubber chips of EPDM, for the elastic aggregate, or by using a synthetic aggregate which is formed from colored ceramics or the like.

[0023] The method of applying (laying) the pavement material is as follows. The hard aggregate and the elastic aggregate are mixed together and the binder is added to the mixture to prepare the pavement material. The urethane binder may be prepared by mixing in advance an isocyanate group terminated prepolymer, a polyol, and optionally a coloring agent, an organic silane, a hardening accelerating agent or the like. Alternatively, the urethane binder may be prepared such that the isocyanate group terminated prepolymer and the polyol are mixed together, and then the coloring agent, the organic silane, the hardening accelerating agent, or the like is mixed with the mixture thereafter. Any method may be used for mixing the aggregates and adding the binder as long as the binder is uniformly adhered to the aggregates. The temperature at the time of mixing the aggregates and the binder may be an ordinary temperature. When the temperature is low, hardening is slow, and when the temperature is high, temperature adjustment may be required because hardening is accelerated.

EXAMPLES

[0024] The pavement material was laid in accordance with the applying process shown in the following example. An outline of the processes of work involved in the method of application of a reduced noise elastic pavement in accordance with the present invention, which processes are shown in Fig. 1, is given below.

(1) Road surface milling step (cases 1 and 2): A pavement which has already been laid is milled to a predetermined depth by a road milling machine.
(2) Semi-flexible paving step (case 1): After milling the asphalt pavement which has already been laid, a semi-flexible pavement is laid.
(3) Blast cleaning step: The blast cleaning step is carried out by shot-blasting (at a projection density of 150 kg/m^2), and the blast cleaning pavement is used for the pavement foundation.
(4) Priming step: A primer is applied to the pavement foundation by using a roller brush.

(5) Preparation of mixture: A mixture is prepared by mixing a hard aggregate, an elastic aggregate, a urethane binder, and the like by a mixer. The preparation of the mixture is carried out at the vicinity of an area to be paved. As the area to be paved changes, the place at which the preparation of the mixture is carried out is also moved together with an asphalt finisher.

(6) Paving step: Taking an extra-banking into account, the mixture is applied and leveled at a speed of 0.5 to 1 m per minute by using the asphalt finisher.

(7) Compacting step: Compaction is carried out by using a 2.5 ton tandem roller or a vibrating tamper.

(8) Opening the road to traffic: The hardening of the mixture is confirmed, and then, the road is opened to traffic.

[0025] Details of the mixture of the present invention are shown in Table 1. Measured skid resistance (BPN) and low noise effect (dB) are also shown in Table 1.

Table 1

	Pavement Application Example 1	Pavement Application Example 2	Pavement Application Example 3	Pavement Application Example 4	Pavement Application Example 5*2	Pavement Application Example 6*2
Applying Method	Case 1	Case 2	Case 3	Case 4	Case 4	Case 4
Hard Aggregate [a] diameter mm/ % by volume [b] percentage passing through sieve opening of 1.18 mm	0~2/41 80	0~5/20 8	0~2/40 86	0~10/60 26	0~10/65 2	0~10/6 2
Rubber Chips diameter mm/ % by volume	recycled rubber chips from tires 2~5/41	recycled rubber chips from tires 2~5/60	recycled rubber chips from tires + EPDM colored chip (white) 1~8/40	recycled rubber chips from tires 0.5~5/22	recycled rubber chips from tires 0.5~5/15	recycled rubber chips from tires 5~10/74
volume ratio of hard aggregate to total amount of aggregates (%)	50	25	50	75	81	7.5
Binder % by volume	18	20	20	18	20	20
Coloring Agent *1 % by weight	black (carbon) 2	none	white (titanium) 3	black (carbon) 1	black (carbon) 1	black (carbon) 1
Organic Silane *1 % by weight	γ-glycidoxypropyl-trimethoxysilane 3	γ-mercaptopropyl-trimethoxysilane 1	γ-glycidoxypropyl-trimethoxysilane 3	epoxy based oligomerized organic silane 5	epoxy based oligomerized organic silane 5	epoxy based oligomerized organic silane 5
Skid Resistance (BPN)	66 ◎	61 ○	69 ◎	72 ◎	76 ◎	58 ×
Noise Reducing Effect (dB)	8 ◎	9.2 ◎	7.8 ◎	7.1 ○	6.4 ×	9.8 ◎
General Evaluation (◎~×)	◎	○	◎	○	×	×

Notes: *1: added amount with respect to binder (% by weight)
*2: comparative examples

[0026] The noise reduction effect is measured in the following manner. Noise (dB) in a vicinity of a tire of a passenger vehicle running on a dense grain pavement was measured, and noise (dB) in a vicinity of a tire of a passenger vehicle running on the pavement material in accordance with the present invention was measured. The difference was calculated and is defined as the noise reduction effect. The larger the difference, the superior the noise reduction effect.

[0027] Figs. 2 through 5 show structural examples of the pavement laying cases 1 to 4 of Table 1.

[0028] In accordance with the pavement material of the present invention, superior elasticity, as well as the air permeability and sound absorption due to the optimized voids, results in a significant noise reducing effect over a porous pavement.

Claims

1. A reduced noise elastic pavement material, comprising:

   a hard aggregate;

   an elastic aggregate; and

   a urethane binder which bonds the hard aggregate and the elastic aggregate together;
   wherein the hard aggregate is 10 to 75 % by volume of the total volume of the hard aggregate and the elastic aggregate, and a two-component urethane binder is used as the urethane binder.

2. A reduced noise elastic pavement material according to claim 1, wherein rubber chips, each having a grain diameter of 10 mm or less, substantially form the elastic aggregate.

3. A reduced noise elastic pavement material according to claim 1, wherein a polyol and an isocyanate terminated prepolymer are used as a urethane component in the urethane binder.

4. A reduced noise elastic pavement material according to claim 1, wherein the hard aggregate includes at least 5 % by weight of a component which passes through a sieve opening of 1.18 mm.

5. A reduced noise elastic pavement material according to claim 1, wherein an organic silane is added to the urethane binder in an amount of 0.1 to 5 % by weight based on the weight of the urethane binder.

6. A reduced noise elastic pavement material according to claim 1, wherein a coloring material is mixed with the urethane binder.

7. A reduced noise elastic pavement material according to claim 1, wherein colored rubber chips are used for at least a portion of the elastic aggregate.

8. A method of applying a reduced noise elastic pavement material, comprising the steps of:

   milling a road surface and/or blast cleaning by shot-blasting on a road surface;

   applying a primer to the road surface;

   mixing a hard aggregate, an elastic aggregate, a urethane binder by using a mixer to prepare a mixture;

   applying the mixture to the road surface; and

   compacting the mixture;
   wherein the hard aggregate is 10 to 75 % by volume of the total volume of the hard aggregate and the elastic aggregate, and a two-component urethane binder is used for the urethane binder.

9. A method of applying a reduced noise elastic pavement material according to claim 8, wherein the step of mixing includes supplying an elastic aggregate formed by rubber chips having a grain diameter of no more than 10 mm.

10. A method of applying a reduced noise elastic pavement material according to claim 8, wherein the step of mixing includes supplying a hard aggregate including at least 5 % by weight of a component which passes through a sieve opening of 1.18 mm.

11. A method of applying a reduced noise elastic pavement material according to claim 8, wherein the step of mixing

includes adding 0.1 to 5 % by weight of an organic silane to the urethane binder.

12. A method of applying a reduced noise elastic pavement material according to claim 8, wherein the step of mixing includes mixing a coloring material with the urethane binder.

13. A method of applying a reduced noise elastic pavement material according to claim 8, further comprising the step of using colored rubber chips for at least a portion of the elastic aggregate.

14. A reduced noise elastic pavement material according to claim 2, wherein the hard aggregate includes at least 5 % by weight of a component which passes through a sieve opening of 1.18 mm.

15. A reduced noise elastic pavement material according to claim 14, wherein the step of mixing includes using a polyol and an isocyanate terminated prepolymer as a urethane component in the urethane binder.

16. A reduced noise elastic pavement material according to claim 15, wherein 0.1 to 5 % by weight of an organic silane is added to the urethane binder.

17. A reduced noise elastic pavement material according to claim 15, wherein the step of mixing includes mixing a coloring material with the urethane binder.

18. A reduced noise elastic pavement material according to claim 15, wherein colored rubber chips are used for at least a portion of or the elastic aggregate.

19. A reduced noise elastic pavement material according to claim 16, wherein a coloring material is mixed with the urethane binder.

20. A method for making a reduced noise elastic pavement comprising the steps of:

milling a road surface and/or blast cleaning by shot-blasting on a road surface;

applying a primer to the road surface;

mixing a hard aggregate, an elastic aggregate and a urethane binder by using a mixer to prepare a mixture;

applying the mixture to the road surface; and

compacting the mixture;
wherein the hard aggregate is 10 to 75 % by volume of the total volume of the hard aggregate and the elastic aggregate, and a two-component urethane binder is used for the urethane binder.

FIG. 1

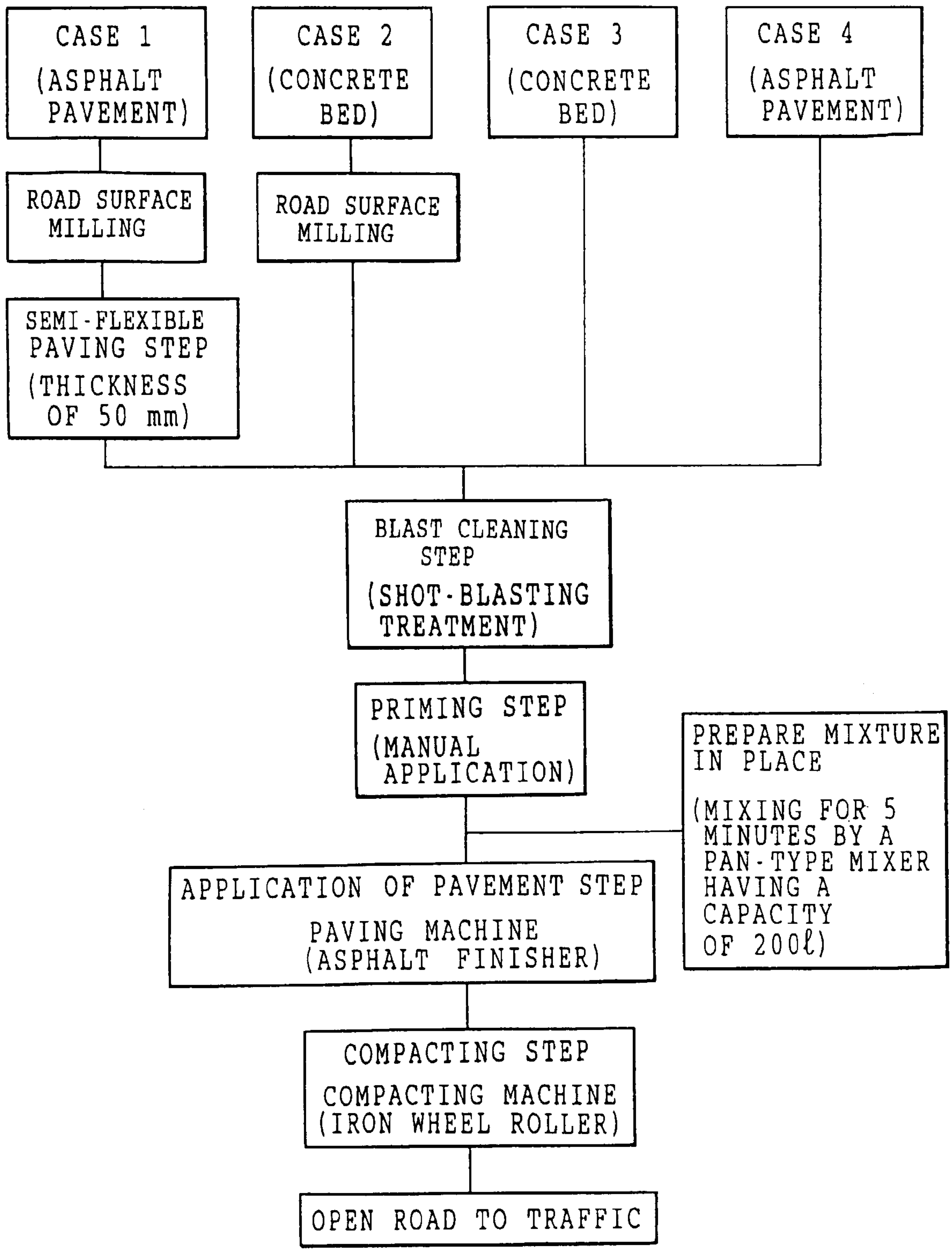

CASE 1
(ASPHALT PAVEMENT)
CASE 2
(CONCRETE BED)
CASE 3
(CONCRETE BED)
CASE 4
(ASPHALT PAVEMENT)
ROAD SURFACE MILLING
ROAD SURFACE MILLING
SEMI-FLEXIBLE PAVING STEP
(THICKNESS OF 50 mm)
BLAST CLEANING STEP
(SHOT-BLASTING TREATMENT)
PRIMING STEP
(MANUAL APPLICATION)
PREPARE MIXTURE IN PLACE
(MIXING FOR 5 MINUTES BY A PAN-TYPE MIXER HAVING A CAPACITY OF 200ℓ)
APPLICATION OF PAVEMENT STEP
PAVING MACHINE
(ASPHALT FINISHER)
COMPACTING STEP
COMPACTING MACHINE
(IRON WHEEL ROLLER)
OPEN ROAD TO TRAFFIC

FIG. 2

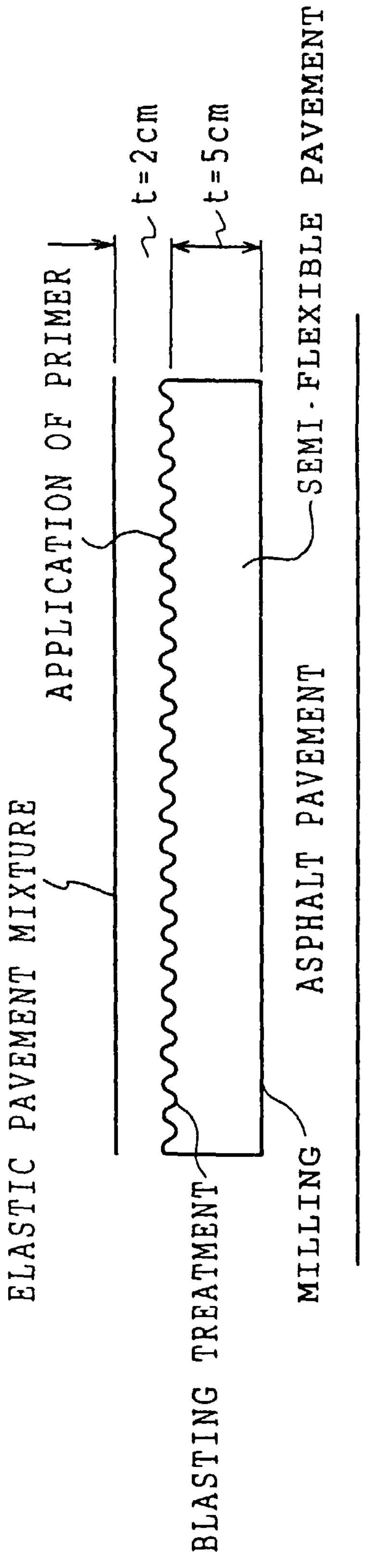

ELASTIC PAVEMENT MIXTURE
APPLICATION OF PRIMER
t=2cm
t=5cm
BLASTING TREATMENT
MILLING
ASPHALT PAVEMENT
SEMI-FLEXIBLE PAVEMENT

FIG. 3

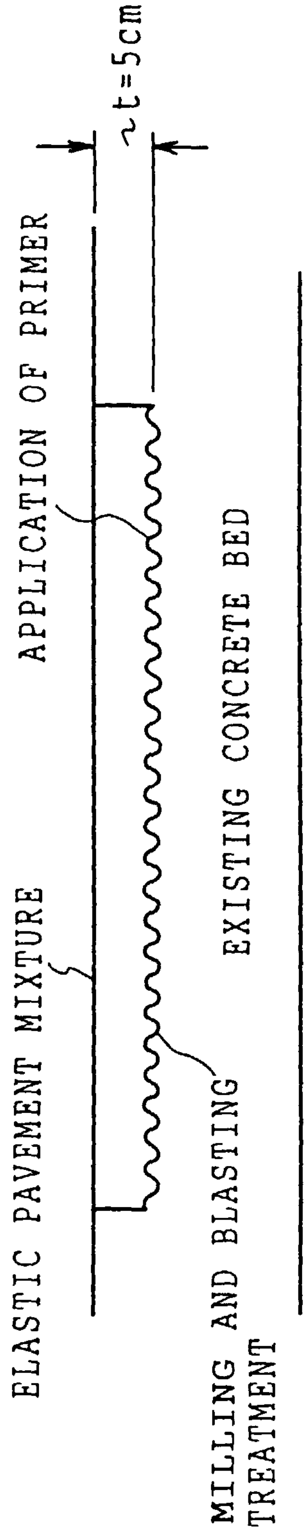

~t=5cm
APPLICATION OF PRIMER
ELASTIC PAVEMENT MIXTURE
EXISTING CONCRETE BED
MILLING AND BLASTING
TREATMENT

FIG. 4

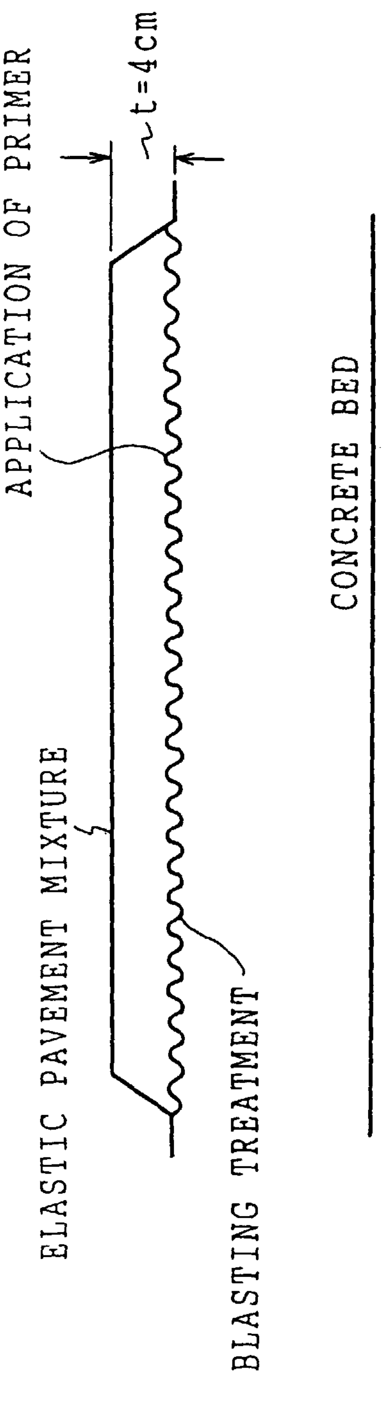

APPLICATION OF PRIMER
~t=4cm
CONCRETE BED
ELASTIC PAVEMENT MIXTURE
BLASTING TREATMENT

FIG.5

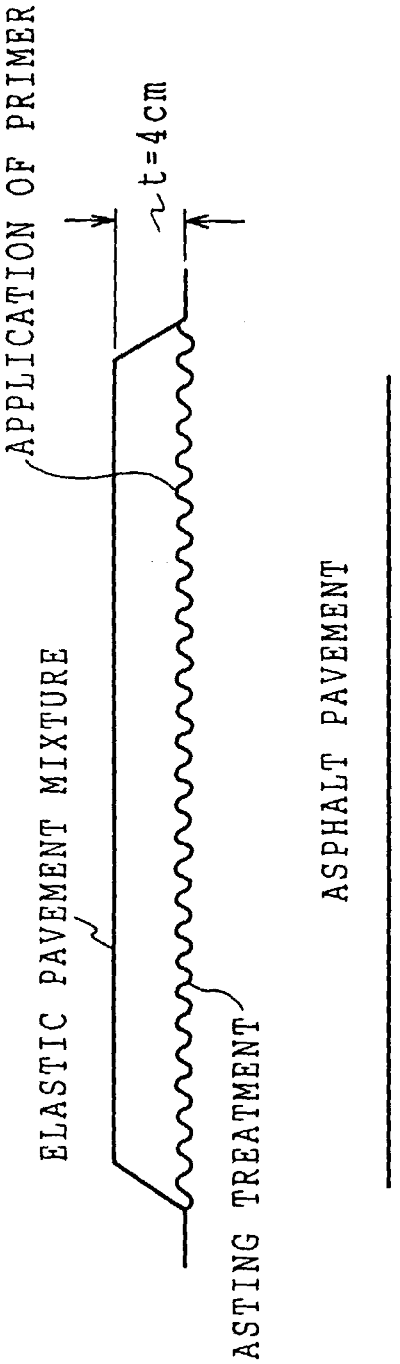

APPLICATION OF PRIMER
t=4cm
ELASTIC PAVEMENT MIXTURE
BLASTING TREATMENT
ASPHALT PAVEMENT

FIG. 6

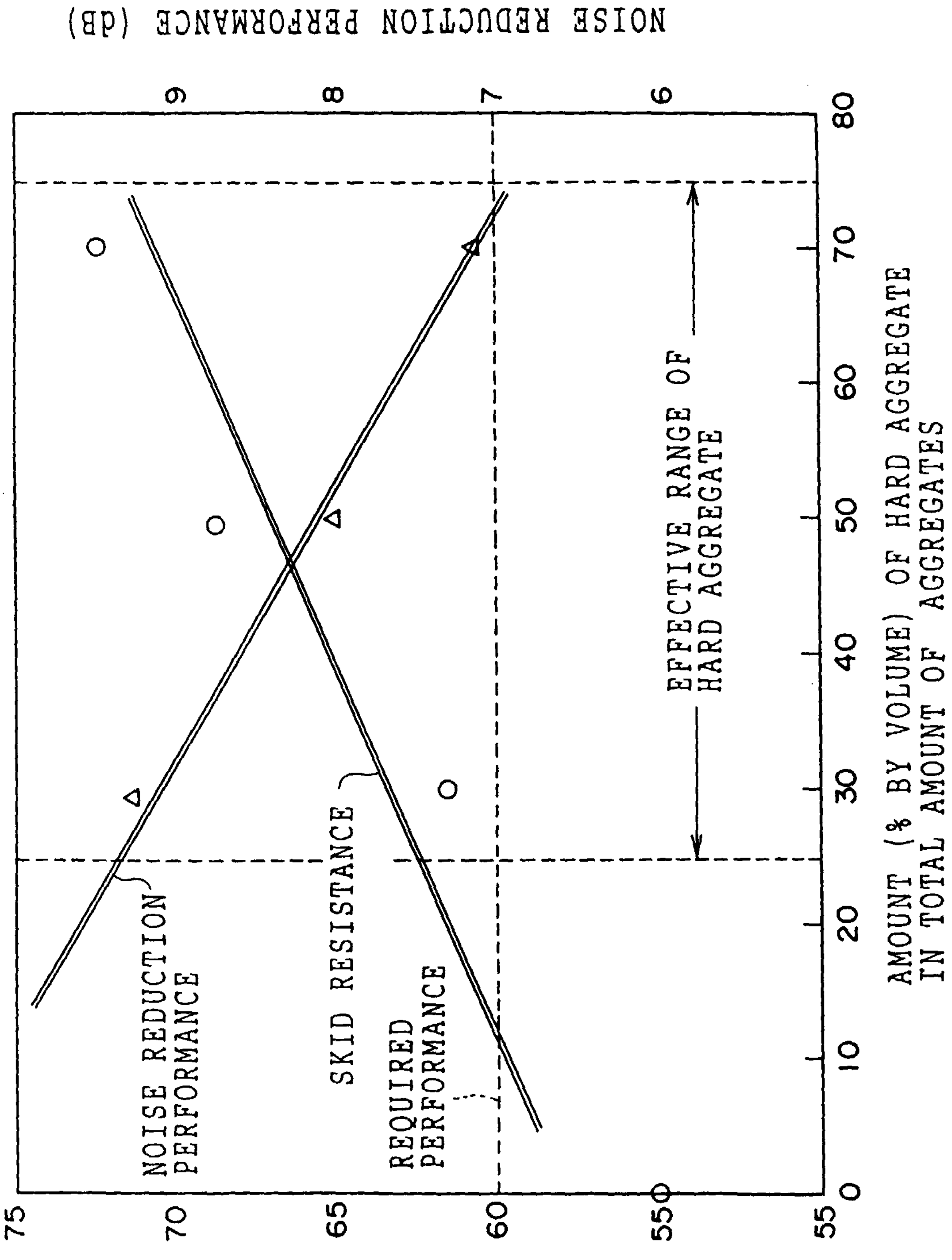
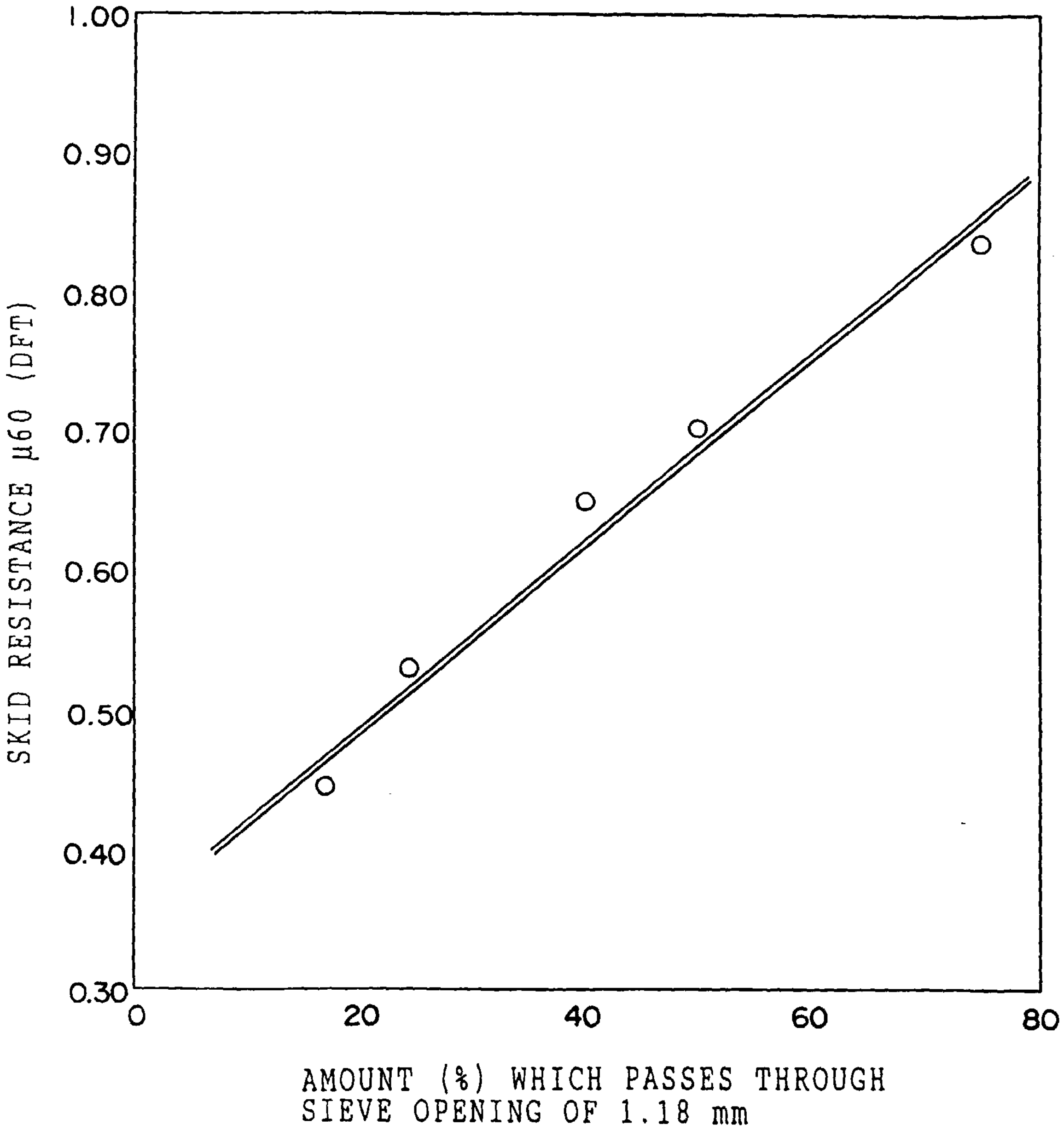

NOISE REDUCTION PERFORMANCE (dB)
SKID RESISTANCE (BPN)
AMOUNT (% BY VOLUME) OF HARD AGGREGATE IN TOTAL AMOUNT OF AGGREGATES
NOISE REDUCTION PERFORMANCE
SKID RESISTANCE
REQUIRED PERFORMANCE
EFFECTIVE RANGE OF HARD AGGREGATE
75
70
65
60
55
9
8
7
6
5
0
10
20
30
40
50
60
70
80

FIG. 7


1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
SKID RESISTANCE μ60 (DFT)
0
20
40
60
80
AMOUNT (%) WHICH PASSES THROUGH
SIEVE OPENING OF 1.18 mm

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 10 9166

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.7)
X	WO 95 25076 A (YAMABISHI IND CO LTD ;TAISEI ROTEC CORP (JP); POTTER GRAHAM D (GB)) 21 September 1995 (1995-09-21) * page 1, line 3 - line 14 * * page 3, line 25 - page 20, line 19 *	1-3,5-9, 11-13,20	E01C7/30 E01C13/06
X	US 3 869 421 A (SAPP GEORGE G ET AL) 4 March 1975 (1975-03-04)	1-3,7	
Y	* column 1, line 10 - line 17 *	6	
A	* column 2, line 37 - column 8, line 54; claim 11 *	8,9,12, 13,15, 18,20	
Y	US 4 564 310 A (THELEN EDMUND ET AL) 14 January 1986 (1986-01-14)	6	
A	* column 1, line 6 - column 4, line 38 *	1,12	
X	DE 31 09 392 A (NEUBAUER WOLFGANG) 21 October 1982 (1982-10-21)	1,2,6,7	
Y	* page 8, line 23 - page 13, line 13; claim 13 *	8,9,12, 13,20	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
Y	DE 196 51 749 A (IHLE CLAUS DIETER) 18 June 1998 (1998-06-18)	8,9,12, 13,20	E01C
A	* column 4, line 2 - line 30; claims 1,2 *	1	
A	GB 1 585 029 A (NAPHTACHIMIE SA) 18 February 1981 (1981-02-18) * page 1, line 16 - line 24 *	1	
P,X	EP 0 957 203 A (TAISEI ROTEC CORP ;BRIDGESTONE CORP (JP)) 17 November 1999 (1999-11-17) * the whole document *	1-4,6-9, 12,13,20	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 August 2000	Zuurveld, G

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

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