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(54) **Absorbent papers and a process for their production.**

(57) An absorbent paper is formed from 5—95% by weight of insoluble amino-formaldehyde resin fibres of 1—10 mm length and 1—30 μm diameter and correspondingly 95—5% cellulose pulp. Where the Canadian Standard Freeness of the cellulose pulp is below 310x + 140 ml. (where x is the proportion of lignin free pulp in the cellulose pulp) the proportion of amino-formaldehyde fibres is such that the blend has a freeness above 220x + 400 ml.

The paper may be made by forming an aqueous slurry of the fibrous constituents into sheet form followed by dewatering.

EP 0 009 322 A1

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Absorbent papers and a process for their production

This invention relates to absorbent papers: such papers find a variety of uses, such as facial or other hygienic tissues, towelling and blotting paper. Depending on the desired and use, other factors besides absorbency, for example bulk, softness, and strength may also be of importance.

Paper is generally made by a wet-laid process wherein a slurry of fibres in water is formed into sheet form, e.g. by deposition of the slurry on to a moving porous surface, e.g. the wire of a Fourdrinier paper making machine, and removing the water, initially by drainage through the porous surface and subsequently by passage of the drained fibrous web through a suitable drier. Generally, to make satisfactory papers, the average length of the fibres should be below 10 mm. The fibres used to make the paper are usually cellulosic: cellulosic pulps are of two main types viz lignin free, e.g. chemical pulp wherein the raw cellulose is converted into a pulp suitable for paper making by chemical means such as the well known sulphite or sulphate processes during which the lignin in the wood is extracted, and lignin containing, e.g. mechanical pulp wherein the raw cellulose e.g. wood is ground to the requisite fibre size without lignin removal. Semichemical and thermomechanical pulps are produced by processes in which little or none of the lignin is removed and so are herein classed with mechanical pulp. Papers made from lignin free, e.g. chemical, pulps have markedly different properties from those made from lignin containing, e.g. mechanical pulps. In some cases the paper may be made from a blend of lignin free and lignin containing pulps in order to obtain a desired balance of properties.

One parameter that has a significant effect on the paper properties is the degree of beating or refining of the pulp: in general the greater the degree of beating the stronger and less bulky is the resultant paper. The degree of beating is conveniently assessed by measuring the freeness of the pulp. In this specification freeness refers to the freeness measured by the Canadian Standard Freeness test procedure: the higher the freeness, the less well beaten is the pulp. The absorbency of the paper is also affected by the freeness: generally the higher the freeness, i.e. the less well beaten, the greater the absorbency.

We have found that absorbent papers may be obtained by making the paper from certain mixtures of cellulose pulp and fibres formed from an amino-formaldehyde resin such as a urea-formaldehyde (UF) resin.

Paper formed from mixtures of UF resin fibres and cellulose pulps have been described in our copending UK patent application 10404/77. In that application the cellulose pulp had a Canadian Standard Freeness of less than 400 ml (chemical pulp) or 120 ml (mechanical pulp).

We have now found that absorbent papers can be made using amino-formaldehyde resin fibres mixed with cellulose pulps having somewhat higher freenesses. Also, where the proportion of amino-formaldehyde resin fibres is high, absorbent papers can be made with cellulosic pulps having lower freenesses.

By the term absorbent paper we mean that the paper has a water-absorption capacity exceeding 3: this may be determined by saturating a weighed quantity of air dry paper with water, lightly shaking to remove excess water, followed by reweighing. The absorption capacity is calculated as the weight of water absorbed per unit weight of the air dry paper. In general absorbent papers according to the invention have a greater water-absorption capacity than the most absorbent paper that can be made, under the same paper-making conditions, from the cellulose pulp employed. For example, an unbeaten or very lightly beaten chemical wood pulp may have a freeness of about 600 ml and paper made therefrom may have a water absorption capacity of about 3. By the addition of 20% UF fibres to the same wood pulp, the water absorption capacity may be increased to about 3.4. Alternatively stronger papers may be made: thus by beating the cellulose pulp to a freeness of about 450 ml prior to blending with the 20% of UF fibres, a paper can be made that is stronger than the most absorptive pure cellulose pulp paper achievable from this cellulose pulp and yet has similar absorption characteristics.

In order to obtain absorbent papers from cellulose pulps that have been fairly well beaten, it is necessary to incorporate such an amount of amino-formaldehyde resin fibres that the resultant blend has a high freeness. The relationship between freeness of a mixture of lignin containing and lignin free, e.g. a mixture of mechanical and chemical, pulps and the freenesses of the individual pulps is, for the purposes of the present invention, sufficiently linear to be quoted as

$$F = fc\,x + fm\,(1 - x)$$

where F is the freeness of the mixture of pulps
fc is the freeness of the lignin free pulp
fm is the freeness of the lignin containing pulp
x is the weight proportion of the lignin free pulp in the mixture.

On the other hand the relationship between the freeness of a blend of amino-formaldehyde resin fibres and a cellulose pulp and the individual freeness of the amino-formaldehyde resin fibres and the cellulose pulp is not linear. However, as a guide, if a lignin free, e.g. chemical, pulp of freeness 400 ml is mixed with an equal weight of UF fibres the resultant blend will have a freeness of about 600 ml. Likewise a lignin containing, e.g. mechanical, pulp of freeness 120 ml mixed with an equal weight of UF fibres gives a blend of freeness about 380 ml.

According to the present invention we provide an absorbent paper product formed from a blend of fibrous constituents comprising

5 to 95% by weight of amino-formaldehyde resin fibres which are insoluble in cold water and have an average length between 1 and 10 mm and a mean diameter between 1 and 30 µm, and, correspondingly, 95 to 5% by weight of cellulose pulp, provided that, where the Canadian Standard Freeness of the cellulose pulp is below 310 x + 140 ml (where x is the proportion by weight of lignin free pulp in said cellulose pulp) the proportion of amino-formaldehyde resin fibres in the blend is such that the Canadian Standard Freeness of the blend is above 220 x + 400 ml.

Thus, considering the case where the cullulose pulp is wholly a lignin free, e.g. chemical, pulp, i.e. x = 1, the pulp should have a freeness above 450 ml. Where, however, the pulp freeness is below 450 ml., absorbent papers can be made with blends containing sufficient amino-formaldehyde resin fibres to give a blend of freeness above 620 ml. Likewise where the cellulose pulp is wholly a lignin containing, e.g. mechanical, pulp, i.e. x = o, the pulp freeness should be above 140 ml., but where it is below this figure, absorbent papers can be made with blends containing sufficient amino-formaldehyde resin fibres to give a blend of freeness above 400 ml.

The amino-formaldehyde resin used to make the fibres is a condensate of an amino compound, preferably a polyamine such as urea or melamine, with formaldehyde. The amino compound is preferably urea, alone or in admixture with up to 5% by weight of melamine. The molar ratio of formaldehyde to amino groups is preferably between 0.6:1 and 1.5:1, particularly between 0.7:1 and 1.3:1.

The amino-formaldehyde resin fibres may be made by any suitable fibre forming technique such as wet or dry spinning and are preferably formed by a centrifugal spinning process, for example as described in our German OLS Specification 2810535, which gives, as is preferred, substantially straight and unbranched fibres.

The amino-formaldehyde resin fibres should have an average length, weighted by length, of between 1 and 10 mm, preferably between 2 and 6 mm. Preferably substantially all the amino-formaldehyde resin fibres have a length within the range 1 to 10 mm. The amino-formaldehyde resin fibres should have a mean diameter between 1 and 30 μm, preferably between 2 and 20 μm, and particularly between 5 and 15 μm. Preferably substantially all the amino-formaldehyde resin fibres have a diameter between 1 and 30 μm.

The amino-formaldehyde resin fibres preferably have an average strength of at least 50 MNm^{-2} (which corresponds approximately to 33 Nmg^{-1}), particularly at least 100 MNm^{-2} ($\equiv$ 67 Nmg^{-1}).

The amino-formaldehyde resin fibres should be cured to such an extent that they are insoluble in water: thus their solubility in water at 25°C should not exceed 1.5% by weight.

Cellulose fibres that may be used include mechanical wood pulp, chemical wood pulp, such as is produced by the sulphate or sulphite pulping processes, thermomechanical and semichemical wood pulps. Alternatively the cellulose pulp may be cotton linters, linen fibres derived from rags, or other cellulose fibres conventionally used in paper making. Depending on their source and method of production they may or may not contain substantial quantities of lignin. Thus cotton linters are substantially free of lignin.

The absorbent papers may be made by the conventional wet laid process, e.g. as hereinbefore described, after preparation and blending of the fibrous ingredients into a paper-making fibrous stock. The absorption capacity and bulk of the paper can be increased if the conventional step of pressing the wet paper sheet prior to drying is omitted.

Papers containing a high proportion of amino-formaldehyde resin fibres tend to have relatively poor strengths. The strength of such papers may be increased by incorporating a binder into the paper: the binder can be added to the aqueous slurry of the fibrous constituents or can be incorporated in a subsequent impregnation or coating stage. Thus the binder may be sprayed on to the wet web or it may be coated on to the dry or partly dried paper. Different methods are appropriate to different binder systems, as is well known to those skilled in the paper making art.

Binders may also advantageously be incorporated in papers containing lesser proportions of amino-formaldehyde resin fibres.

Examples of suitable binders include starch or modified starch, polymer latices, water soluble polymers such as poly(ethylene imine), poly(acrylamide), and poly(vinyl pyrrolidone). The binder is preferably treated to render it cationic in water. Particularly favoured are cationic binders added with the fibres-including, in addition to those binders already mentioned, cationic starch and urea - or melamine-formaldehyde resins, as conventionally used to achieve increases in paper wet strength. Typically the amount of binder employed is from 0.01 to 10%, preferably 0.1 to 5%, by weight of the fibrous ingredients.

The paper products of the present invention contain 5 - 95% by weight of amino-formaldehyde resin fibres and correspondingly 95 - 5% by weight of cellulose fibres. The properties of the paper will vary considerably as the proportions of the respective fibres are varied: thus as the proportion of amino-formaldehyde resin fibres increases, absorbency and bulk increases. Generally as the proportion of amino-formaldehyde resin fibres increases so the freeness of the cellulose pulp should be reduced in order to obtain adequate strength, although it will be appreciated that for some applications strength is not important, for example in highly absorbent products where an absorbent paper layer is attached, e.g. by an adhesive or stitching, to a supporting web.

The paper products preferably contain at least 15%, and preferably less than 80%, by weight of amino-formaldehyde resin fibres.

The paper products may be creped, by conventional means, as a way of increasing their bulk and also, incidentally, to improve their stretch. Creping may not be necessary with papers comprising predominantly amino-formaldehyde resin fibres but in the latter case it may be desirable to incorporate one or more of the aforementioned binders. Where the amount of amino-formaldehyde resin fibres is relatively low, i.e. below about 35% by weight, the paper will be soft and bulky and may require creping on conventional equipment to produce a paper acceptable for absorbent applications. However, because of the higher bulk conferred by the amino-formaldehyde resin fibres, the severity of the creping process may be reduced as compared with conventional papers.

At intermediate levels (i.e. 35 - 75% by weight) of amino-formaldehyde resin fibres, the papers may be acceptable for some absorbent applications, but for others may require to be creped.

At high percentages of amino-formaldehyde resin fibres, i.e. above 75% by weight, a very bulky absorbent paper is produced which will need little, if any, creping. It may be desirable though, and particularly with papers containing more than 90% by weight of amino-formaldehyde resin fibres to incorporate a binder as described above.

The advantages of the papers of the present invention, which are conferred by the presence of the amino-formaldehyde resin fibres are improved absorbency, softness, porosity and bulk, often with little or no sacrifice in strength, thus enabling a combination of useful characteristics to be obtained that cannot be achieved with wholly cellulose pulps.

Furthermore, the rapid draining characteristics of amino-formaldehyde resin fibres also confer advantages in processing. It is possible, for example, to increase the dilution of the stock, while maintaining machine speed, and so improve the even formation of the sheet. This may be of particular importance with light weight tissue products.

The invention is illustrated by the following examples in which all percentages are by weight. In the examples the amino-formaldehyde resin fibres employed were urea-formaldehyde (UF) fibres made by centrifugal spinning. An aqueous solution of a urea-formaldehyde resin having a formaldehyde:urea molar ratio of 2:1, a solids content of 65%, and a viscosity of 45 poise, was mixed continuously with 10% of a solution containing 1.66% poly(ethylene oxide) of weight average molecular weight 600,000 and 6.66% ammonium sulphate. The resulting mixture was fed at a rate of 200 g/min. to a 13 cm diameter spinning cup rotating at 10,000 rpm. The resin was spun as fibres from the cup into an atmosphere of air at 150°C, and then the fibres were removed therefrom and cured by heating for 3 hours at 120°C to render them insoluble in cold water. The resultant fibres were shredded and further disintegrated in a laboratory valley beater. The shredded, beaten, fibres had an average fibre length of about 3 mm and an average diameter about 10 µm. Substantially all the fibres had a length within the range 1 - 10 mm and a diameter within the range 3 - 20 µm. The strength of the fibres, measured by short span testing of a loose mat of the fibres, was approximately 120 MNm^{-2}.

In the examples the UF fibres were blended, in specified quantities expressed on a dry fibre basis, with cellulose pulps that had been beaten in a valley beater to specified freenesses. The resultant blends were made into paper handsheets of substance about 60g m^{-2} using a British Standard handsheet former. Except where indicated, the papers were wet pressed.

The papers were tested in the following manner:

Absorption capacity: a small quantity of the paper was weighed, with water, lightly shaken to remove excess water, and reweighed. The absorption capacity was calculated as the weight of water absorbed per gram of air dry paper.

Absorption time: according to the TAPPI Bibulous paper test, T432. The time taken to absorb 1 ml of water was measured.

Klemm absorbency test: this test was modified to conform with the sizes of the paper samples made and with the fact that highly absorbent materials were being tested. A strip of paper, 150 mm x 15 mm was held vertically with 10 mm of the sample immersed in water. The height of the water rise up this strip after 5 minutes was recorded. (Normally a time of 10 minutes is recommended for the Klemm test).

Oil absorption: according to the Patra test using oil S-600.

Burst Index: burst pressure is measured by the TAPPI T403 method and the result in kNm^{-2} is divided by the substance in gm^{-2} to give the burst index.

EXAMPLE 1

In this example a commercially available birch sulphate, i.e. a chemical wood, pulp was used. In order to assess the maximum absorbence obtainable with this pulp, the pulp was dispersed in water in a laboratory disintegrator without any prior beating or refining. Because in the absorption capacity test the paper sample tended to fall apart on total immersion in water and so rendered it impractical to obtain a meaningful value, paper was also made from the same pulp after it had been lightly beaten.

Papers were also made from blends of the cellulose pulp beaten to various degrees with various amounts of the UF fibres. The results are shown in the following table.

Run	% UF	Freeness (ml)		Bulk	Burst Index	Absorb.	Absorb. Time	Klemm rise
		Pulp	Blend	cm^3/g	kNg^{-1}	Capacity	(sec)	(mm).
1.1*	0	+	+	-	0.44	-	146	70
1.2*	0	604	604	-	0.65	2.98	145	56
1.3*	20	284	384	2.06	1.78	2.70	376	40
1.4	20	452	510	2.09	1.11	3.03	177	68
1.5	20	604	612	2.22	0.30	3.38	60	90
1.6	50	452	621	2.69	0.33	3.42	54	101
1.7	50	604	690	2.78	0.11	3.32	25	126
1.8	75	284	691	3.20	0.11	4.01	29	106
1.9	75	452	692	3.37	0.01	4.23	21	118
1.10	75	604	735	3.49	-	5.20	17	112

* comparative

\+ unbeaten pulp

Runs 1.1 and 1.2 demonstrate that the maximum absorbency obtainable with the birch sulphate pulp alone is absorption capacity ~ 3, absorption time $\sim 145 - 146$ sec., and Klemm rise $\sim 56 - 70$ mm.

This example shows that while a paper with 20% UF (run 1.4) has similar absorbency properties to the maximum achievable with the birch sulphate pulp alone, the burst index is much improved. It also demonstrates that absorbent papers may be made using low freeness pulps, if sufficient UF fibres are added - compare runs 1.3 and 1.8.

EXAMPLE 2

To demonstrate the effect of a binder, starch was added to the fibrous mixture from which the papers were made. The cellulose pulp was a birch sulphate pulp beaten to a freeness of 484 ml.

Run	% UF	% starch on fibre weight	Freeness of Blend (incl starch) ml	Bulk cm^3g^{-1}	Burst Index kNg^{-1}	Absorb. capacity	Klemm Rise (mm)
2.1*	0	0	484	1.46	2.30	2.95	41
2.2*	0	3	411	1.42	4.30	2.69	38
2.3	50	3	616	2.90	0.62	3.87	138
2.4	75	10	696	3.46	0.12	5.19	>140

* comparative

By comparison with starch free systems of similar blend freeness and UF content in Example 1, e.g. compare run 2.3 with run 1.6 and run 2.4 with run 1.9, it is seen that adding starch improves both the absorbency and burst index.

EXAMPLE 3

The procedure of Example 1 was repeated using a commercially available unbleached mechanical wood pulp in place of the birch sulphate pulp. In one case, run 3.7, the paper was made omitting the wet pressing step. The results are shown in the following Table.

Run	% UF	Freeness (ml)		Bulk cm^3/g	Burst Index kNg^{-1}	Absorb. Capacity	Absorb. Time (sec)	Klemm Rise (mm)
		Pulp	Blend					
3.1*	0	437	437	-	-	3.32	205	45
3.2*	20	69	110	2.59	0.84	3.01	758	32
3.3	20	437	503	2.90	0.27	3.84	195	60
3.4	50	145	423	3.24	0.20	3.82	75	69
3.5	50	437	548	3.46	0.11	3.94	138	59
3.6	75	69	544	3.54	0.10	4.2	21	108
3.7+	75	69	544	4.8	0.08	5.49	13	122
3.8	75	87	570	4.51	0.11	4.47	34	100
3.9	75	145	613	3.46	0.06	4.61	49	85

* comparative

\+ not wet pressed.

Again it is seen that if sufficient UF fibres are incorporated, absorbent papers can be made with low freeness cellulose pulps.

EXAMPLE 4

The procedure of Example 1 was repeated using as the cellulose pulp a mixture of 70% bleached pine sulphate and 30% bleached birch sulphate. In some cases 3%, on fibre weight, of starch was added and, in all these runs, the wet pressing step was omitted. The water absorption time quoted is the time taken to absorb 0.1 ml of water rather than 1 ml as in the previous examples.

Run	% UF	Freeness (ml)		Bulk cm^3/g	Burst Index kNg^{-1}	Oil Absorb. (sec)	Water Absorb. time (sec)	Klemm Rise (mm)
		Pulp	Blend					
4.1*	0	587	587	3.25	1.83	0.4	5.8	99
4.2*	0	638	638	3.50	1.21	0.6	6.5	94
4.3*	0	650	650	3.62	0.97	0.8	4.6	108
4.4	20	587	675	3.53	1.03	0.2	5.5	110
4.5	20	638	700	3.48	0.76	<0.1	6.1	103
4.6+	20	640	705	3.72	1.60	0.2	8.6	90
4.7	20	650	675	2.68	0.55	0.3	4.4	106
4.8	40	587	712	3.95	0.45	<0.1	3.9	109
4.9	40	638	725	3.88	0.34	<0.1	4.6	112
4.10+	40	640	728	3.76	0.85	0.1	5.3	94
4.11	40	650	725	3.97	0.29	<0.1	3.5	114

* comparative

\+ starch added

EXAMPLE 5

The procedure of Example 1 was repeated using as the cellulose pulp a birch sulphate wood pulp of freeness 425 ml. The results are shown in the following Table, together with data for a commercial blotting paper and a commercial absorbent paper towelling.

Run	% UF	Blend freeness (ml)	Bulk (cm^3g^{-1})	Burst Index kNg^{-1}	Absorb. time (sec)	Klemm rise (mm)
5.1	10	460	1.72	2.26	44	43
5.2	20	500	1.92	1.93	42	46
5.3	30	535	2.13	1.40	21	64
5.4	40	570	2.28	1.00	18	70
5.5	50	605	2.48	0.80	9	86
5.6	60	642	2.81	0.40	9	102
5.7	70	680	3.06	0.23	6	113
5.8	80	715	3.29	0.11	1*	115
5.9	90	752	4.42	0.06	3*	82
5.10	blotting paper		1.78	0.73	44	48
5.11	absorbent towelling		4.12	0.56	20*	25

* time to absorb 0.1 ml water

The papers of runs 5.1 to 5.9 all had absorption capacities in excess of 3.

PA/CG/MP
26 July 1979

1. An absorbent paper product formed from a blend of fibrous constituents comprising 5 - 95% by weight of amino-formaldehyde resin fibres which are insoluble in cold water and have an average length between 1 and 10 mm and a mean diameter between 1 and 30 µm, and, correspondingly 95 - 5% weight of cellulose pulp, provided that, where the Canadian Standard Freeness of said cellulose pulp is below 310 x + 140 ml (where x is the proportion by weight of lignin free pulp in said cellulose pulp), the proportion of amino-formaldehyde resin fibres in the blend is such that the Canadian Standard Freeness of said blend is above 220 x + 400 ml.

2. An absorbent paper product as claimed in claim 1 wherein the fibrous constituents comprise 15 to 80% by weight of the amino-formaldehyde resin fibres and, correspondingly, 85 to 20% by weight of cellulose pulp.

3. An absorbent paper product as claimed in claim 1 or claim 2 containing 0.01 to 10% by weight, based on the weight of the fibrous constituents, of a binder.

4. An absorbent paper product as claimed in claim 3 wherein the amino-formaldehyde resin fibres form at least 70% by weight of the fibrous constituents.

5. An absorbent paper product as claimed in any one of claims 1 to 4 that has been creped.

6. An absorbent paper product as claimed in claim 5 in which the amino-formaldehyde resin fibres form less than 35% by weight of the fibrous constituents.

7. An absorbent paper product as claimed in any one of claims 1 to 6 wherein the amino-formaldehyde resin fibres are fibres of a resin formed by condensing formaldehyde with urea and 0 to 5% by weight, based on the weight of urea, of melamine.

8. An absorbent paper product as claimed in any one of claims 1 to 7 wherein the molar ratio of formaldehyde to amino groups in the amino-formaldehyde resin is between 0.6:1 and 1.5:1.

9. An absorbent paper product as claimed in any one of claims 1 to 8 wherein the amino-formaldehyde resin have an average fibre length in the range 2 to 6 mm with substantially all the fibres having

lengths within the range 1 to 10 mm.

10. An absorbent paper product as claimed in any one of claims 1 to 9 wherein the amino-formaldehyde resin fibres have a mean diameter within the range 2 to 20 µm with substantially all the fibres having diameters within the range 1 to 30 µm.

11. A process for the production of an absorbent paper product according to any one of the preceding claims comprising forming an aqueous slurry of the fibrous constituents, forming said slurry into sheet form, and removing the water.

12. A process as claimed in claim 11 wherein the sheet is not pressed prior to drying.

13. A process as claimed in claim 11 or claim 12 wherein the sheet is creped after drying.

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Application number

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EUROPEAN SEARCH REPORT

EP 79 30 1669

Category	DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
	FR - A - 2 373 617 (ICI) * Claims 1,2,9; page 3, lines 3-35; page 4, lines 5-23; examples 1-10 * --	1,2,7, 9-12	D 21 H 5/20 A 61 L 15/00
	GB - A - 572 962 (SYLVANIA INDUSTRIAL CORP.) * Claims 1-4; page 2, line 8 - 99 page 3, lines 60-130; page 4, lines 1-33, 60-83 and 122-124; page 5, lines 4-17 * --	1,11, 12	
	GB - A - 1 232 870 (NESTE) * Page 1, lines 8-50, 59-90; page 2, lines 1-80 * --	1,11, 12	TECHNICAL FIELDS SEARCHED (Int.Cl. 3) A 61 L 15/00 D 01 F 6/76 D 21 H 5/20
	FR - E - 87 511 (CTA) * Entire document * --	1,11, 12	
	FR - A - 2 048 786 (MOLNLYCKE) * Claims 1,4,12; figure 1; page 1, line 1 - page 3, line 19; page 4, lines 12-34 * --	1	CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
P	FR - A - 2 382 542 (ICI)(claiming GB priority 10.404/1977, cited in the text of the application under examination) * Entire document * ----	1,3,4, 7-12	
X	The present search report has been drawn up for all claims		&: member of the same patent family, corresponding document

Place of search	Date of completion of the search	Examiner
The Hague	03-12-1979	NESTBY

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