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EUROPEAN QUALIFYING EXAMINATION 2022

Paper A

This paper comprises:

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Letter from the applicant

Molinar & Barxell
Papers d'Alcoi

Mr Arturo Barea, Patentes
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Madrid

Dear Mr Barea,

[001] Paper is the most commonly-used support material for documents in archives and libraries.

[002] Paper is composed of cellulose fibres derived from plants. Paper quality depends largely on the fibre source and the production method, which determine the length of the cellulose fibres. Long-fibred paper is stronger, more flexible and more durable than short-fibred paper.

[003] In Europe, the practice of beating cotton and linen cloth rags to separate the cellulose fibres into a paste called pulp, and then using screens to form sheets of paper from this pulp, began in the 13th century. Hemp and flax were also commonly included to make the pulp. The term for the resulting product is "rag paper".

[004] Rag paper is known for its chemical and mechanical stability. Thanks to its pure cellulose fibres, which are long and strong, rag paper is exceptionally durable and lasts hundreds of years under normal use. In most cases, rag paper dating back as far as the 1500s is strong, light in colour and flexible.

[005] Wood pulp paper, by contrast, is a soft paper made from ground wood and began to be widely used as of the 1850s. Wood also contains substances other than cellulose, such as lignin. When exposed to UV light and heat, wood pulp paper deteriorates rapidly, becoming yellow and brittle. This is due to the short cellulose fibres of ground wood and the inherent acidity of lignin. Wood pulp paper produced before the 1950s is typically found in poor condition in printed material in archives and libraries.

[006] Our company manufactures durable paper for paper records intended for long-term retention, such as important legal documents, and for preservation photocopies in archives and museums. We employ traditional papermaking techniques that have been known for centuries and may not be patentable. However, we believe that our durable paper has unique properties, as explained below. We are relying on you to devise the best strategy for obtaining patent protection for our entire technology. We are aware that it may be necessary to draft several independent claims in various categories. However, we do not wish to incur additional costs and the European application should not involve the payment of claims fees.

[007] We basically stick to the traditional method of making paper pulp by stamper beating as described in T. Barrett’s Encyclopedia of Papermaking "Paper through Time", because it largely preserves the long fibres of cellulose. The relevant passages are appended as document D1. We believe that you will need this document to draft the patent application.

[008] The first thing we would like to stress is that we do not use cotton and linen cloth rags to make our paper pulp. Using cotton and linen cloth rags requires bleaching, which is environmentally damaging. Of course, we do not use wood either. Instead, we only use raw plant material such as flax, hemp, straw, hay, thistles or nettles, or mixtures thereof, which does not contain lignin. We collect the raw plant material in our region. This makes our technology cheaper and more sustainable. We are currently striving to obtain an ecolabel.

[009] Our method of making paper pulp begins with raw plant material. In other words, we replace the initial steps of the traditional method, i.e. soaking, fermenting and bleaching the cloth rags (see D1), with a step of treating the raw plant material with quicklime. This step is required to extract the cellulose.

[010] The treatment with quicklime is preferably performed by: a) grinding the raw plant material, b) soaking the ground plant material in water (typically 20 litres per 1 kg of plant material), c) adding quicklime (typically 1.5 kg per 1 kg of plant material), d) mixing into a slurry, and e) drawing off the water.

[011] We took this method from an old patent dated 1801, which expired a long time ago and is attached (document D2) as background information.

[012] In this method, it is essential that the mixing with quicklime lasts at least 5 days, preferably 6 to 8 days, otherwise the cellulose extraction will not be complete.

[013] The treated plant material is then transformed into paper pulp by stamper beating using a stamper machine.

[014] The general set-up of traditional stamper machines comprises a vat (1) fitted with a hammer consisting of a hammer head (2), a hammer shaft (3), and a hammer face (4). The stamper machine typically strikes 40 blows a minute. Under these conditions, beating to soften and plasticise the pulp takes at least 12 hours, and usually up to 24 hours.

[015] However, when paper sheets are formed from this pulp, the quality and strength of the resulting paper is poor compared to paper made from cotton and linen cloth rags. Furthermore, the paper is very rough and so has a pronounced surface texture.

[016] These drawbacks can be diminished by sizing. Sizing refers to the application of a coating by soaking the sheets of paper in a glue solution, such as starch or gelatin, and then drying them. Sizing strengthens the paper surface and prevents ink from bleeding into the fibres, ultimately yielding sharper print quality. This is essential for our purposes. We preferably use gelatin sizing, which provides smoother surfaces. Typically, a gelatin solution with a concentration of about 3% is used.

[017] Unfortunately, the traditional method of sizing by soaking and drying the paper sheets is cumbersome and takes too long.

[018] One of our inventors, Mr D. Séchard, first thought that these drawbacks could be tackled by adding the glue to the pulp directly in the vat of the stamper machine during beating. However, beating the pulp together with the glue resulted in a sharp increase in the viscosity of the mixture, hindering the circulation and homogeneous treatment of the pulp. The paper pulp obtained in this way was found to be unsuitable for our purposes.

[019] To achieve an effective circulation of the pulp in the vat and a homogeneous distribution of the glue during beating, we have adapted the stamper machine to our needs by making several modifications to the construction of the hammer (see Figure 1). Positioning the hammer head (2) at a slant to the hammer shaft (3) plays an essential role in the stamper beating process. Positioning at a slant means a head-to-shaft angle (α) set at a fixed angle deviating from 90 degrees.

[020] The effective circulation of the pulp thus achieved is due to the head swept volume increasing considerably the more the head-to-shaft angle (α) deviates from 90 degrees. Head swept volume refers to the volume of pulp in the vat that is displaced as the hammer head falls and rises.

[021] Unpublished calculations by Mr Séchard based on a hypothetical stamper machine show that head swept volume increases by 10% to 40% when the head-to-shaft angle (α) is set at between 82 and 60 degrees, as compared to an unslanted hammer head (2) set at 90 degrees to the hammer shaft (3).

[022] To achieve a head-to-shaft angle (α) smaller than 70 degrees, which is preferred, the shaft-to-horizontal angle also has to be modified. In our set-up, the hammer shaft (3) has a 5-degree downslope in resting position. This is illustrated in Figure 1.

[023] Our design ensures that the pulp is circulated so that over 90% of the pulp volume in the vat is swept/displaced with each stroke of the hammer. This enhanced pulp circulation is essential to homogeneously intermix the glue in the viscous pulp, and thus to achieve the desired paper strength and surface quality. The enhanced pulp circulation can easily be verified by taking samples from the top layer and samples from the bottom of the vat and then measuring their viscosity. Differences in viscosity should not be greater than 1%. Methods for measuring viscosity are well known in the art.

[024] Once the pulp is ready, paper sheets are made according to the traditional method comprising pouring the pulp onto a screen (typically a linen fabric, a metal mesh, or a wire cloth stretched on a wooden frame). Once most of the water has filtered through, a thin layer of pure cellulose fibres homogeneously intermixed with the glue is left on the screen. This layer is then pressed, dried, stripped from the screen, cut and flattened.

[025] The paper obtained in this manner is chemically inert and has excellent endurance and age-resistant properties. It has a smooth surface for printing that is impermeable enough for ink not to bleed into the fibres. The homogeneously intermixed glue gives the cellulose fibres greater coherence and bonding properties. We manufacture paper sheets with a grammage of 70 g/m^2. This is the grammage most commonly found in historical rag paper from the 17th and 18th centuries.

[026] We have tested the tensile strength of our paper according to the standard method (ISO 1924-2). Tensile strength refers to the maximum stress required to tear a strip off a sheet. With a tensile strength of above 1 900 N/m, preferably above 2 600 N/m, our paper outperforms historical rag paper, which always has a tensile strength of well below 1 900 N/m.

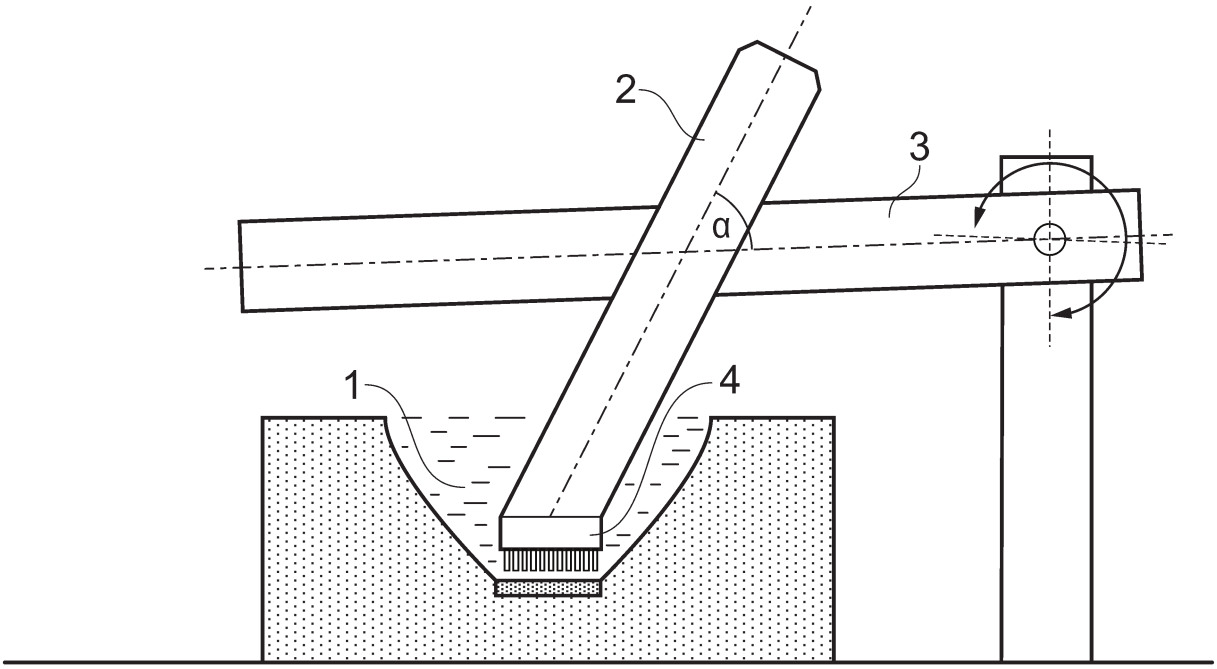

FIG. 1

Document D1

[001] T. Barrett's Encyclopedia of Papermaking "Paper through Time"

[002] In the following chapter we discuss the traditional method of making paper pulp by stamper beating using cloth rags obtained from discarded textiles, and suitable apparatus for doing so.

[003] The traditional method of making paper pulp comprises the steps of soaking, fermenting and bleaching cotton and linen cloth rags, followed by beating in vats fitted with hammers to separate the cellulose fibres into a pulp.

[004] This pulp is then poured onto screens made of a linen fabric, a metal mesh or a wire cloth stretched on a wooden frame. Once most of the water has filtered through, a thin layer of cellulose fibres is left on the screen. This layer is then pressed, dried, stripped from the screen, cut and flattened. The sheets are subsequently submitted to sizing to provide a smooth and impermeable writing or printing surface. In earlier times, vegetable paste (starch) was used for sizing, but this was later replaced with animal glue (gelatin).

[005] Most of the papermaking mills in Europe are still equipped with old stamper machines (as shown in Figure 1) in keeping with tradition. It is believed that the paper obtained from pulp made in traditional stamper machines is better than that obtained using other types of beating machines, because stamper beating better preserves the length of the cellulose fibres.

[006] The general set-up comprises a number of vats (1) each fitted with a hammer consisting of a hammer head (2) solidly attached at a fixed 90 degree angle to a hammer shaft (3). The face of the hammer (4) may be fitted with iron or bronze nails (Figure 2) designed to perform a specific task.

[007] Hammers with sharp nails (5) are designed to break down the pieces of cloth rag into smaller bits and threads.

[008] Hammers with rounded or flat nails (6) are designed to beat and separate the cellulose fibres. This softens and plasticises the cellulose fibres into a pulp.

[009] Hammers without nails and consisting entirely of plain wood (7) are designed to brush out the pulp by freeing it of flocs.

[010] Most paper mills have six vats: three for breaking the cloth rags, two for beating them into pulp, and one for brushing out of the pulp.

[011] Each hammer strikes 40 blows a minute when it is functioning properly. Breaking the cloth rags takes 6 to 12 hours, and beating them into pulp takes another 12 to 24 hours or longer, depending on the strength of the material.

[012] Determining when beating is complete is a matter of experience. To be ready, the pulp has to be as homogeneous as milk and have the consistency of buttermilk.

[013] A number of construction details (vat shape, hammer size, hammer lift distance, etc.) can be tailored specifically to promote even treatment of the pulp.

[014] Once ready, the pulp is removed from the vats, and formed into paper sheets with the aid of screens, as explained above.

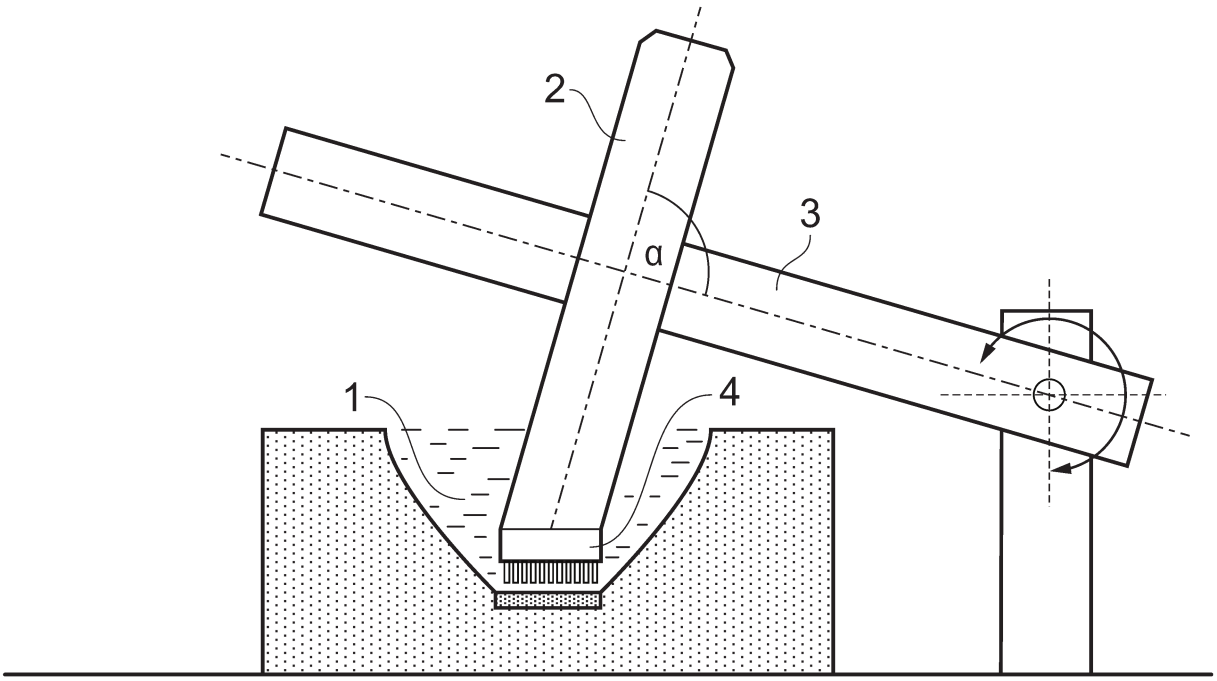

FIG. 1

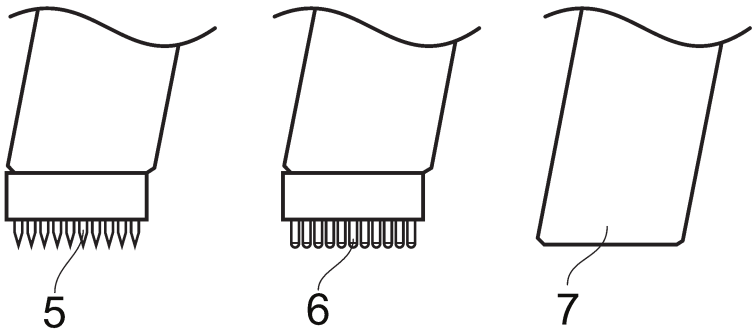

FIG. 2

Document D2

[001] Specification of the patent granted to Matthias Koops, Gentleman, of James Street, in the Parish of St. Margaret, Westminster, in the County of Middlesex, dated February 17, 1801.

[002] Manufacturing paper from straw, hay, thistles, nettles, waste and refuse from hemp and flax, and different kinds of wood and bark, fit for printing and other useful purposes.

[003] (For 1 kg of straw or hay, etc.):
a) Dissolve 1.5 kg of quicklime in 20 litres of river water.
b) Grind straw, hay, etc.
c) Soak the ground material in the quicklime solution in a vessel and mix for at least 5 days, preferably for 8 days.
d) Draw off the water.
e) Proceed to transform this material into paper pulp by the usual process of stamper beating.

[004] The pulp is then formed into sheets with the aid of screens. The paper sheets are pressed, dried, and submitted to gelatin sizing according to the usual process by soaking the sheets in a 3% gelatin solution and drying.

[005] The gelatin sizing makes the most significant contribution to the strength of the finished paper sheet.

[006] If a smooth surface is required, the paper sheets are glazed using a smooth stone.