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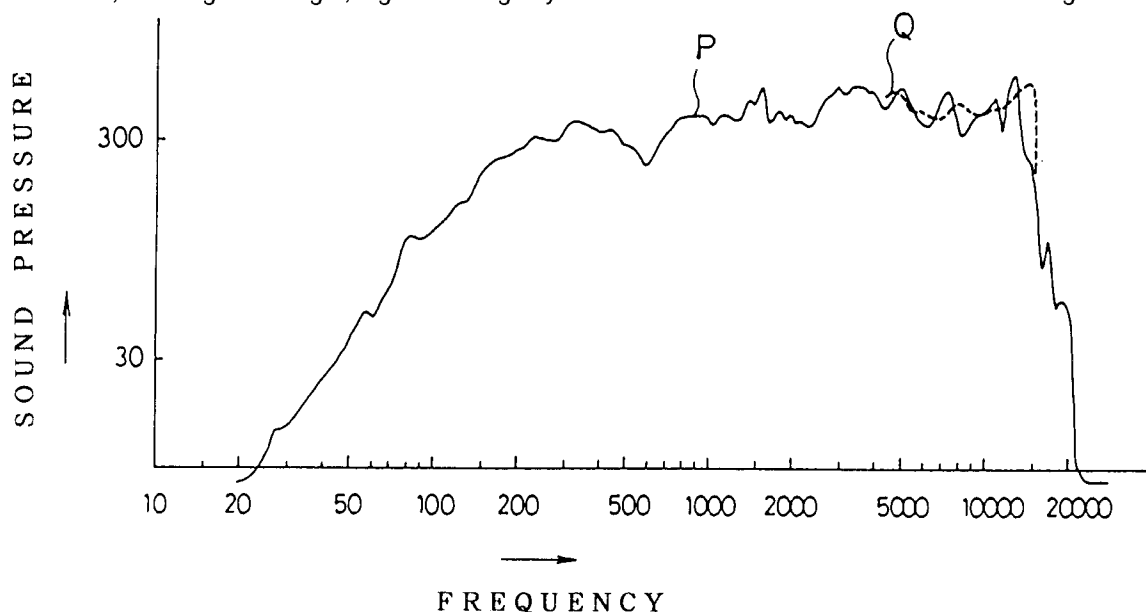
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NL-1000 HB Amsterdam (NL)(54) **Loudspeaker diaphragm for use in electroacoustic transducer.**

(57) A loudspeaker diaphragm is obtained with a fibrous material containing at least a kenaf fiber as a substitute for wooden fiber, the material being subjected to paper-making steps. The loudspeaker diaphragm thus manufactured with such non-wooden fiber can be made to closely resemble the one manufactured with the wooden fiber, to be light in weight, high in the rigidity and internal loss and still low in manufacturing costs.

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(Field of Utilization in Industry)

This invention relates to improvements in a paper-made loudspeaker diaphragm for use in electroacoustic transducers.

(Prior Art)

For the loudspeaker diaphragm, in general, it is demanded to have such excellent solid state properties that the density is small to be high in the elasticity, a proper internal loss is provided, no mechanical fatigue is provided while excellent in the weathering properties, and so on.

While there have been various ideas suggesting to use, as ones satisfying the foregoing solid state properties, a variety of high polymer materials, metallic materials, ceramic materials and the like, they are all troublesome in respect of the control of the foregoing solid state properties and manufacturing complexity, and are high in the manufacturing costs.

On the other hand, the paper-made loudspeaker diaphragm has been frequently utilized because of an easiness of the control of the foregoing solid state properties and of the manufacture. Dynamical properties of this paper-made loudspeaker diaphragm are determined by the solid state properties of single fiber employed, or by coupling strength and coupling area between fibers.

While wooden pulp has been generally employed as the material for the currently employed paper-made loudspeaker diaphragm from the viewpoint of costs, on the other hand, the reckless deforestation is mentioned in recent years as a problem in respect to the terrestrial environmental destruction. Since in this case global warming and desertizing phenomena can be prevented by means of conservation of forest, it has become an important theme to reconsider non-wooden paper resources. For the purpose of the conservation of forestal resources, therefore, it has been demanded to provide a substitute material for wood so as to reduce the amount used of wood.

In contemplating a remarkable reduction in the amount used of wood for the purpose of the conservation of the forestal resources taking into account the restriction of the terrestrial environmental destruction, it may be first mentioned to utilize reclaimed paper. However, used paper is generally stocked outdoor so as to be deteriorated due to such various factors as rainwater, sunshine, decomposing fungi and so on, and the employment of the used paper placed under such conditions involves a problem particularly in respect of obtention of the high rigidity when such paper is used for making the diaphragm, and it is difficult to obtain a loudspeaker diaphragm having uniform solid state properties.

It is possible on the other hand to employ such tubular fibrous bundle fiber as straw, bamboo, Manila hemp or the like as the non-wooden fiber in making the loudspeaker diaphragm, whereas, when these materials are used, there arises a problem that satisfactory solid state properties and tone cannot be obtained with the thus made loudspeaker diaphragm employed in the acoustic products. Further, there has been also employed for the paper-made loudspeaker diaphragm such bast fiber as paper mulberry, *Edgeworthia papyrifera* of flax, but there has been involved a problem that the same has been poor in the productivity so as to be expensive.

(Technical Field)

Consequently, an object of the present invention is to provide a loudspeaker diaphragm for use in the electroacoustic transducers, which is manufactured on the premise that the non-wooden fiber is employed and yet can be sufficiently a substitute for the one made of the wooden fiber, and is excellent in the productivity to be inexpensive.

As the result of keen study made by the present inventors, it has been found to be extremely useful to employ kenaf fiber as the substitute material for wood.

Kenaf is an annual plant which is remarkably shorter in the rearing period than wood and can be reared even in a desolation, and its fibrous characteristics and eventually its solid state properties when used in the loudspeaker diaphragm are closely resembling the wooden fiber.

Here, fibrous length and width of pulps of whole kenaf stalks, kenaf bast, bleached kraft (LBKP), Manila hemp and wood (NBKP) are shown in a following Table I:

TABLE I

Type of Pulp	Fibrous Length (mm)	Fibrous Width (μm)
Whole kenaf stalk	1.28	34
Kenaf bast	2.5	23
LBKP	1 to 2	20
Manila hemp	2 to 8	16 to 32
NBKP	2 to 4	30

A paper-made loudspeaker diaphragm according to the present invention employing the kenaf fiber among the materials in the above Table shows to be light in weight and high in the rigidity and to have a high internal loss, and can be contributive to the restriction of the terrestrial environmental destruction.

In order to establish the above purpose, according to the present invention, the loudspeaker diaphragm is manufactured by subjecting the kenaf fiber alone or mixed with other fibrous material to paper-making step.

In another embodiment of the present invention, a moisture-proofing or a waterproofing is carried out with respect to the foregoing loudspeaker diaphragm.

(Function)

The solid state properties of kenaf fiber show, when used as the material for the loudspeaker diaphragm, values equal to or more desirous than those of the wooden fiber, and can provide substantially the same characteristics as the paper-made loudspeaker diaphragm comprising the wooden fiber.

(Embodiment)

The present invention shall be detailed in the followings with reference to an embodiment. Here, the kenaf pulp employed in the present invention is prepared in manner described later. That is, as the seeds, a "Blue Skin" No. 3 produced in China and "Everglade" (EG) Nos. 41 and 47 produced in U.S.A. were employed, these seeds were reared in Japan to obtain kenaf, which plant after the harvest was dried sufficiently, chipped to be about 5cm long in the fibrous material, and pulped while separating into bast part and woody part.

Conditions for preparing a kraft pulp were as in the followings. That is, the degree of xanthation was 25%, effective alkali was 16%, liquid ratio was 1:7, digesting temperature was 170 °C, digesting time was 3.5 hours and Rohe value was 3.2, upon which the total yield was 48%.

Here, bleached kenaf kraft pulp and the one obtained by subjecting this kraft pulp to a beating with PFI mill were employed, they were formed into a sheet through hand papering, and the solid state properties were evaluated mainly by Vibration Lead method.

In this case, there were prepared as samples a sheet containing the "Blue Skin" No. 3, a sheet containing EG-41 and a sheet containing EG-71, and results of measurement with respect to each of them were as shown in Table II.

TABLE II

SAMPLE	BLUE SKIN No.3		EG-41		EG-71	
	Bast (Beating)	Woody Part (Maceration)	Bast (Beating)	Woody Part (Maceration)	Bast (Beating)	Woody Part (Maceration)
Beating Degree °SR	34	35	29	35	30	32
Weighing g/m ²	101	107	106	108	99	102
Density g/cm ³	0.49	0.85	0.51	0.85	0.49	0.82
Young's Modulus N/m ²	2.9x10 ⁹	7.9x10 ⁹	4.5x10 ⁹	7.2x10 ⁹	3.8x10 ⁹	8.1x10 ⁹
Sound Velocity m/s	2590	3060	2970	3020	2780	3140
Internal Loss tanδ	0.039	0.043	0.038	0.045	0.039	0.042

As will be clear from Table II, it has been found that the solid state properties when employed in the respective loudspeaker diaphragms show desirable values more than equal to those of the wooden pulp (NBKP). Further, other than the above properties, it has been found that the kenaf pulp has such features as follows:

(1) It shows lower water absorption and oil permeability than NBKP, and has water-resisting and oil-resisting effect.

(2) When used as mixed and papered with the wooden pulp, it increases the bulk, and the rigidity as the loudspeaker diaphragm is improved.

5 (3) It is possible to use as the loudspeaker diaphragm even without being subjected to the beating.

(4) When employed as beat, the beating proceeds faster than the wood pulp, and an energy saving can be attained upon the production.

10 Further, a loudspeaker diaphragm was prepared by employing a pulp made with the woody part in the foregoing sample EG-71 kept non-beat, upon which alkyl ketene dimer (ACOPEL 12 made by DICK-HERCULES K.K.) was used as a sizing agent.

The thus prepared loudspeaker diaphragm according to the present invention and a loudspeaker diaphragm prepared with the wooden pulp and formed into mutually the same shape were employed respectively to construct each of loudspeakers of a diameter of 10cm, and they were subjected to a measurement of high frequency characteristics. As the result, as shown in an accompanying drawing, the
15 loudspeaker employing the kenaf pulp diaphragm has shown such frequency characteristics as represented by a broken line Q, comparable with such frequency characteristics as represented by a solid line P of the loudspeaker employing the wooden pulp (NBKP).

It is also effective to carry out the moistureproofing and waterproofing with respect to the loudspeaker diaphragm, so that the diaphragm can be provided with sufficient moisture resistance and water resistance
20 so as to have good aptitude for use in many foreign countries of high temperature and high humidity.

(Effect of the Invention)

According to the present invention of the foregoing arrangement, the loudspeaker diaphragm employing
25 the kenaf pulp has the solid state properties of desirable values equal to or more than the loudspeaker diaphragm employing the conventional wooden pulp, so that there can be realized such effect that the loudspeaker diaphragm of light weight, high rigidity and high internal loss can be obtained, and the wood is made unnecessary by the employment of the kenaf pulp so as to be able to attain the conservation of
30 forestry resources and to be effectively contributive to such restriction of the terrestrial environmental destruction as the prevention of global warming and desertizing phenomena.

Brief Explanation of the Drawing:

The drawing is a frequency characteristics diagram with respect to the sound pressure of the
35 loudspeaker employing the diaphragm in an embodiment according to the present invention and the loudspeaker employing the conventional wooden pulp.

Claims

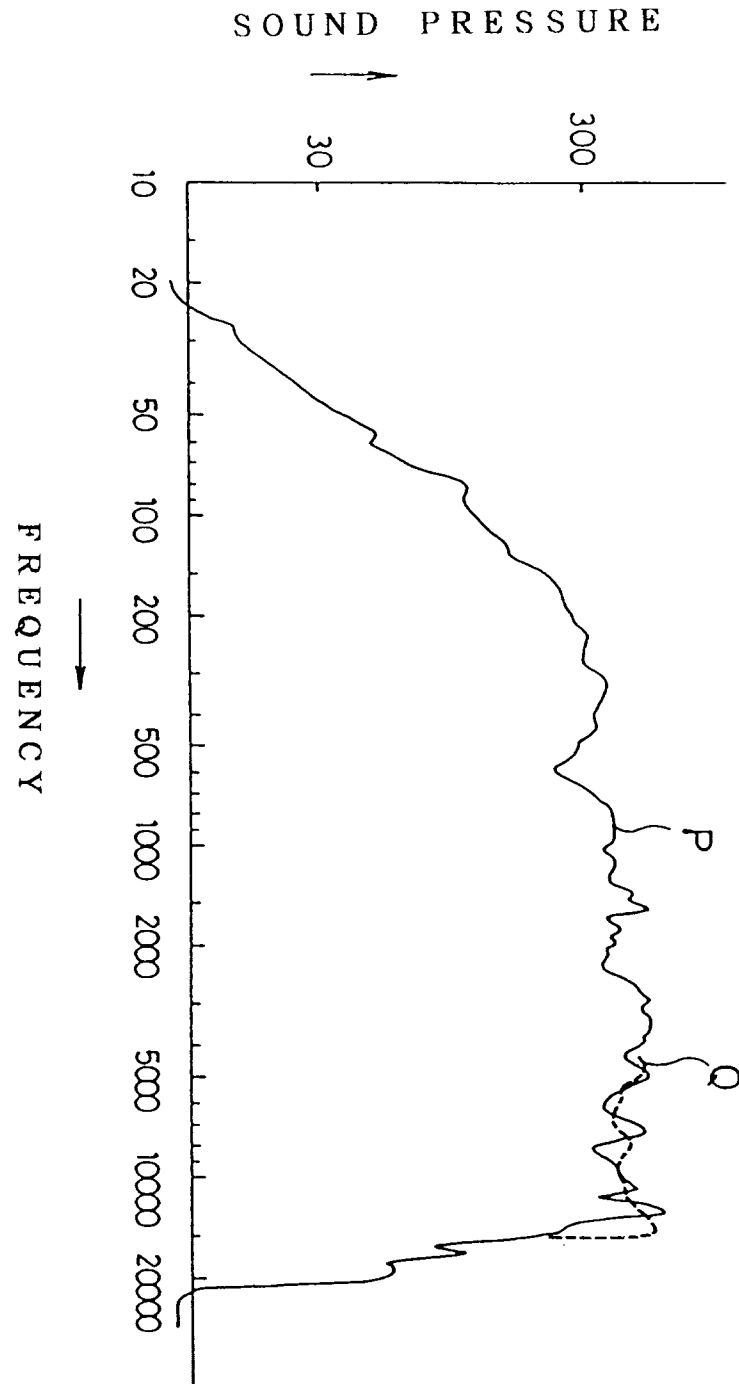
40 1. A loudspeaker diaphragm characterized in comprising a fibrous material containing at least a kenaf fiber and subjected to a paper-making step.

2. A loudspeaker diaphragm according to claim 1, wherein said kenaf fiber is used alone as said fibrous material.

45 3. A loudspeaker diaphragm according to claim 1, wherein said fibrous material contains said kenaf fiber and another fiber.

50 4. A loudspeaker diaphragm according to any one of claims 1 to 3, which is subjected to a moistureproofing.

5. A loudspeaker diaphragm according to any one of claims 1 to 3, which is subjected to a waterproofing.





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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0460

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)
Y	GB-A-2 245 451 (SANSUI ELECTRIC CO LTD)	1	H04R7/02
A	* page 5, line 8 - page 6, line 2 * ---	3	H04R31/00
Y	TAPPI JOURNAL, vol.70, no.11, November 1987, ATLANTA US pages 81 - 83 JIM YOUNG 'Kenaf newsprint is a proven commodity' * the whole document * ---	1	D21C5/00
A	TAPPI, vol.63, no.1, January 1980, NEW YORK US pages 53 - 55 G. F. TOUZINSKY ET AL. 'Papermaking properties of kenaf thermomechanical pulp' * the whole document * ---	1	D21H11/12
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 326 (E-1102) 20 August 1991 & JP-A-03 120 999 (ONKYO CORP ET AL.) * abstract * ---	1,2	
A	PATENT ABSTRACTS OF JAPAN vol. 012, no. 077 (E-0589) 10 March 1988 & JP-A-62 216 494 (PIONEER ELECTRONIC CORP) * abstract * -----	4,5	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 31 May 1994	Examiner Gastaldi, 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 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 I : document cited for other reasons ----- & : member of the same patent family, corresponding document			