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## FELT MAKING PROCESS

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This invention relates to felt, more particularly to building felt, adapted to be saturated with waterproofing compounds such as asphalt, coal tar, coal tar pitch or other bituminous waterproofing material, to form substantially waterproof products for building sheathing, roofing, floor coverings and other constructional purposes. This application is a continuation-in-part of my copending application Serial No. 86,098, filed February 4, 1926, now Patent No. 2,029,310, granted February 4, 1936, and is particularly directed to building felts made from fibers, preferably strength fibers, mixed with straw fibers treated under conditions such that the straw fibers have sufficient absorptive capacity, together with strength and hardness properties, to produce a felt which may be saturated with bitumen or other waterproofing material, and which felt has the balanced characteristics of strength, hardness and saturating capacity required for felts employed for roofing, sheathing, floor coverings and other constructional purposes. The invention claimed herein constitutes a species divisible from the species claimed in parent Patent No. 2,029,310.

Heretofore the manufacture of felt intended to be saturated with waterproofing compounds, such as melted bitumen, has usually been accomplished by employing one or more of the following as raw materials:

(1) Rags which contain substantially a mixture of cotton and wool;

(2) Rags consisting substantially of cotton;

(3) Rags which contain jute fiber in the form of waste bagging;

(4) Rags which contain old carpets composed largely of jute with quantities of cotton and wool;

(5) Rags which contain rag clippings of all grades with varying amounts of paper; and

(6) Paper stock composed largely of waste paper.

These materials are partially disintegrated in rag cutters and thereafter, while in suspension in water, are beaten in paper mill beaters, then jordaned if desired, and finally formed into a continuous sheet on Fourdrinier or cylinder paper making machines.

Rags are a relatively expensive raw material and the use of substantial proportions of the same in the manufacture of felt results in a relatively expensive product..

Paper stock is a less expensive raw material than rags, but the use of large quantities of this material in the manufacture of felt tends to harden or stiffen the felt sheets excessively and render them unsuitable for many purposes.

In my co-pending application Serial No. 86,098 I have disclosed the manufacture of felt by mixing strength fibers, highly absorptive fibers and filler fibers, which results in a felt eminently satisfactory for constructional purposes. Examples of strength fibers given in my co-pending application are: (*a*) jute, that is waste bagging otherwise called No. 3 rags, cooked by the calcium pentasulphite process substantially as described in United States Patent No. 996,225 to Viggo Drewsen granted June 27, 1911, then washed until free from spent cooking liquors and afterward defibered in a beating engine; (*b*) raw jute or jute bagging cooked at an elevated temperature of 130° to 150° C. in a solution of sodium carbonate containing about ten per cent by weight of sodium carbonate based on the weight of the raw fiber being cooked (a ten per cent solution of lime may be used instead of the sodium carbonate solution); (*c*) flax tow made from American or Canadian flax straw by the well known breaking process, by which the shive or interior woody portion is largely removed; (*d*) jute or flax tow treated in a beating engine with water at 90° to 100° C. to which approximately 10 per cent alkali, such as caustic soda, lime, etc., based upon the dry weight of the fiber to be treated, has been added, followed by thorough washing with water of the fiber thus produced before it is used as a component in the felt; (*e*) unbleached sulphite pulp; and (*f*) kraft pulp.

As absorptive fibers the following are disclosed: (*a*) spruce or hemlock chips or shavings, cooked by the above mentioned calcium pentasulphide process or by the sodium pentasulphide process, followed by the disintegration into fibers by edge runners or in a beating or Jordan engine; (*b*) wood fibers treated at an elevated temperature of 90° to 100° C. in a beating engine in a solution containing ten per cent of caustic soda based on the weight of the wood material or other alkali solution, followed by the washing of the fibers and their disintegration in a beating engine; (*c*) wheat straw, rye straw, oat straw, rice straw, barley straw or other cereal or annual crop fibers treated in a digester with water at elevated temperatures, for example, from 120° to 150° C. for a short period of time to thoroughly soak the fibrous material, followed by disintegration into fibers in a beating engine; (*d*) such straw or other cereal or annual crop fibers beaten at lower temperatures, for example, 90° to 100° C.; or (*e*) at about 50° C. in a 10 per cent (based on the

weight of the straw) sodium carbonate solution; or (*f*) at atmospheric temperature in a caustic soda solution; and (*g*) cotton hull fiber, namely, minute seed hairs obtained from cotton seed hulls after removal of the cotton and cotton linters, containing a substantial proportion of hull particles, cooked in accordance with the calcium or sodium pentasulphide process, followed by the beating of the resultant fibers.

The following examples of filler fibers are given: (*a*) cereal or other crop fibers such as wheat straw, rye straw, oat straw, rice straw, barley straw, cooked by the calcium or sodium pentasulphide process, followed by the washing of the cooked fibers to free them from spent alkaline liquors and the beating of the washed fibers; (*b*) such straw fibers cooked at an elevated temperature and pressure in sodium carbonate, caustic soda or other alkali solution and afterward washed and beaten; and (*c*) such straw fibers cooked and beaten in a beating engine at 90 to 100° C. in the presence of about ten per cent of caustic soda based on the weight of the straw.

The function of the filler fibers is (*a*) to control the degree of saturation of the sheet and (*b*) to impart hardness thereto. Their use is particularly advantageous in the production of felt when considerable hardness and medium saturating capacity is desired. In general increase of filler-fiber content increases hardness and decreases saturating capacity.

I have also disclosed that certain of the fibers produced as hereinabove described and primarily adapted to serve as filler fibers also have sufficient absorptive capacity so that when admixed with other fibers, such as the strength fibers, a sheet is produced having an intermediate capacity for absorbing waterproofing material and considerably increased hardness; such a sheet is especially adapted for making sheathing paper and bitumen-saturated felt-base floor coverings. This application is particularly directed to the mixing of such filler fibers and other fibers and to the resultant felt.

Filler fibers having sufficient absorptive capacity to adapt them for use in making relatively hard felts to be saturated with bitumen for constructional purposes, disclosed in my copending application are, wheat straw, rye straw, oat straw, rice straw, barley straw or other like straws cooked at an elevated temperature and pressure in sodium carbonate, caustic soda or other alkali solution. Such fibers may be produced by cooking the aforementioned straws in a beating engine containing a solution of ten per cent of caustic soda based on the weight of the straw, while maintaining a temperature of 90° to 100° C. in the beater. The time of beating and cooking the straw will depend on many factors such as the strength of the alkaline solution in which the straw is treated, the amount of the charge of straw introduced into the cooker, the temperature of the solution, etc., and the cooking and beating should be carried out until the fibers are disintegrated to the desired extent, which can be determined by inspecting and testing the fibers in the beater and cooker.

Any of the strength fibers hereinabove enumerated, which it will be noted are non-straw fibers, may be mixed with such straw filler fibers to produce the desired felt. One example of a felt made by mixing such filler fibers and strength fibers given in the specification of my co-pending application is as follows: 15 per cent cooked jute fiber or cooked flax tow, mixed with 85% cooked straw fibers resulted in a felt which would absorb at least approximately 100 per cent, based on the dry weight of the felt, of tar or other bituminous waterproofing material.

It will be noted that, in accordance with the invention claimed in this application, straw fibers are treated under conditions of increased severity as compared with the treatment of such fibers disclosed in my aforementioned co-pending application to produce absorptive fibers, that is to say, the temperature of the treatment of the straw fibers is materially increased or the strength of the alkali employed in the treatment is increased as compared with the temperature or strength of alkalis respectively employed in producing highly absorptive fibers. Thus there are produced fibers which, while less absorptive than the highly absorptive fibers produced under milder conditions of treatment, have sufficient absorptive capacity and strength properties so that they can be used in the formation of felts which can be waterproofed and employed for roofing, flooring and other constructional purposes. In accordance with the claimed invention herein, it is not necessary to treat different batches of straw under different conditions, one more drastic than the other, to produce both absorptive and filler fibers, but by one treatment, preferably of intermediate severity, a fiber is produced from straw which has sufficient absorptive capacity and strength characteristics so that it may be employed along with other fibers such as strength fibers and without the use of highly absorptive fibers to produce an eminently satisfactory felt for constructional purposes.

It is to be understood that the above description is to be interpreted as illustrative and not in a limiting sense, and that this invention is not restricted to the present disclosure otherwise than as is defined by the appended claims.

I claim:

1. A process of producing felt which comprises cooking straw in a caustic soda solution containing about 10% of caustic soda based on the weight of the straw maintained at a temperature of about 90° to 100° C. to produce straw fibers imparting both hardness and absorptive characteristics to a sheet in which they are incorporated, mixing said straw fibers with strength fibers produced from wood and forming the resultant mixture of fibers into a felt sheet consisting entirely of said straw and strength fibers.

2. A process of producing felt which comprises treating straw from the group, wheat straw, rye straw, oat straw, rice straw and barley straw, in a solution containing about 10 per cent of caustic soda based on the weight of the straw at a temperature of about 90° to 100° C. to produce fibers imparting both hardness and absorptive characteristics to a sheet in which they are incorporated, mixing said straw fibers with strength fibers produced from wood, and forming the resultant mixture of fibers into a felt sheet consisting entirely of said straw fibers and strength fibers.

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