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METHOD OF MANUFACTURING WOOL OR SILK-LIKE FIBRES FROM THE COLLAGEN SUCH AS FATTY LAYERS, TENDONS, ETC. OF ANIMALS

Filed Oct. 23, 1940

Serial No. 362,480

2 Sheets-Sheet 1

Fig. 1.

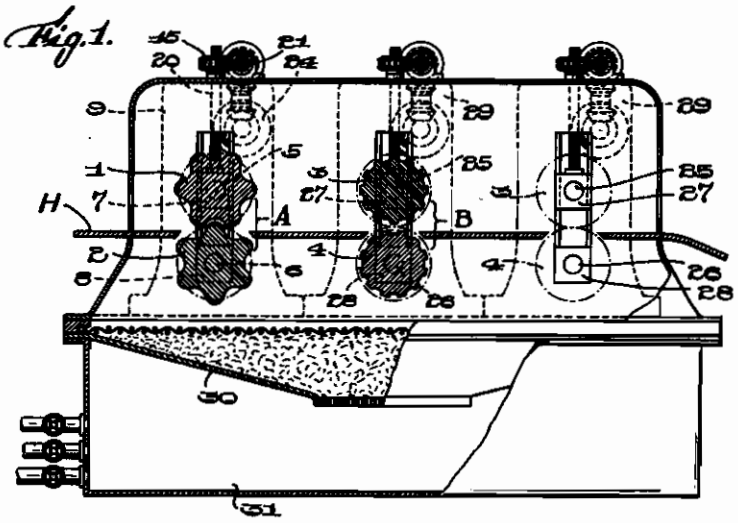

Fig. 3.

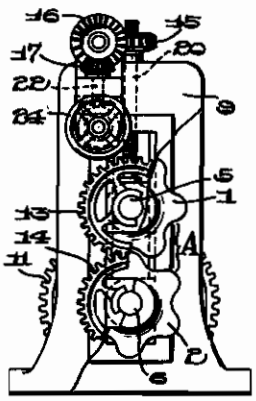

Fig. 2.

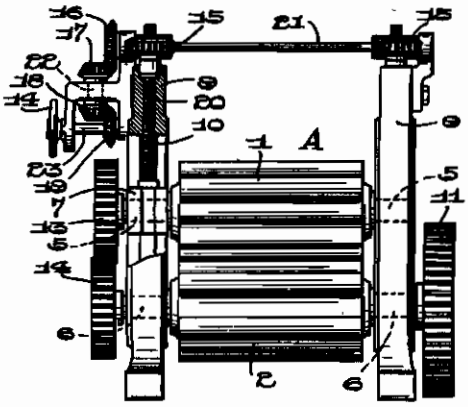

Fig. 4.

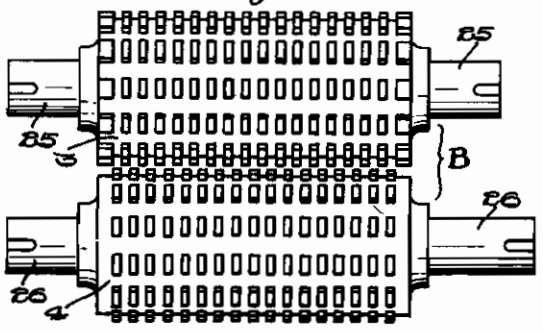

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Fig. 5.

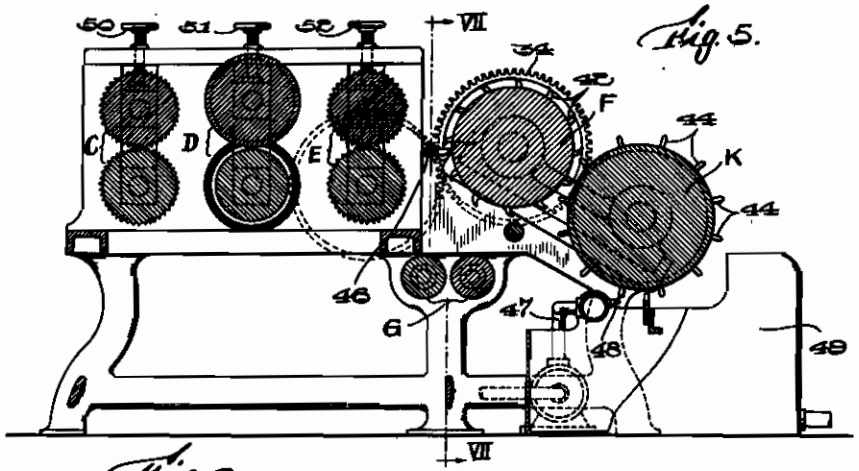


Fig. 6.

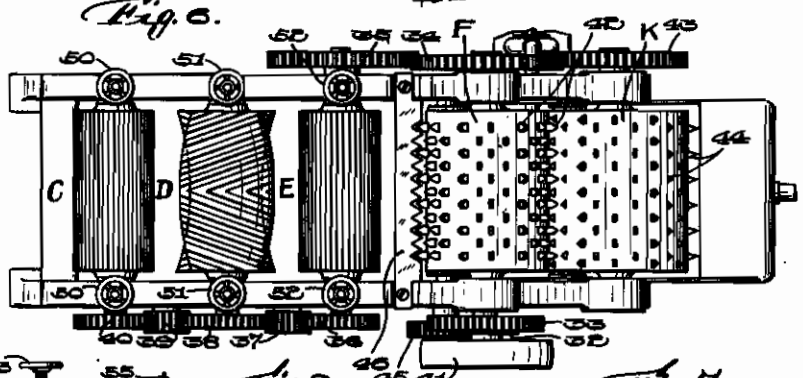


Fig. 8.

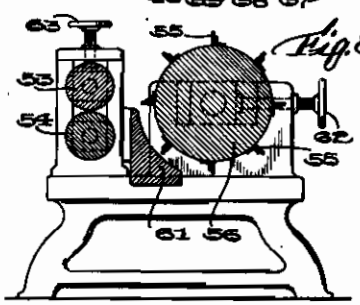


Fig. 7.

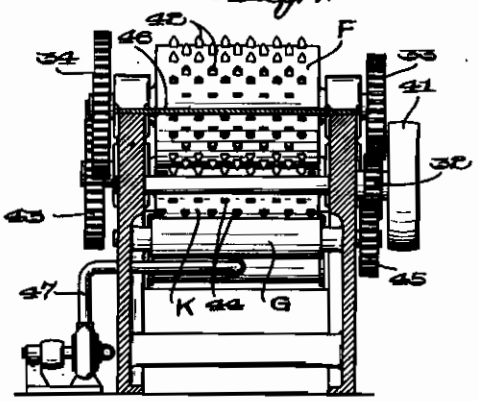
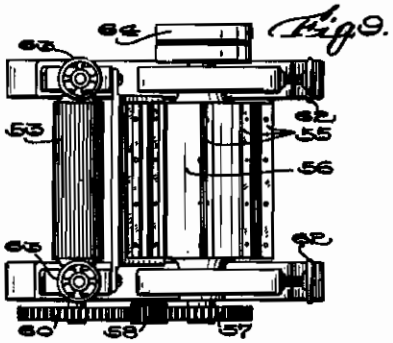


Fig. 9.



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ALIEN PROPERTY CUSTODIAN

METHOD OF MANUFACTURING WOOL OR SILK-LIKE FIBRES FROM THE COLLAGEN SUCH AS FATTY LAYERS, TENDONS, ETC. OF ANIMALS

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Application filed October 23, 1940

The present invention relates to a method of manufacturing wool or silk-like fibre from the collagen of marine animals, especially the whale and shark and the tendons of the whale, shark and cattle and the tissue surrounding the sperm head oil of the sperm whale.

The primary object of this invention is to produce the tenacious spinnable fibre to be substituted as wool or milk from the residues left after oil is pressed out out from the fatty layers and other parts of marine animals such as the whale and shark as well as land animals. Another object is to remove useless substances from the fibre without damaging the latter and also to facilitate the separation of the fibre.

The further object is to render said fibre waterproof by treating the same with a fixing agent such as formalin and chromium chloride.

The fatty layers of the whale, shark, etc. generally consist of about 65% of oil and fat and 20% of fibre, the rest being elastin and water. Said fibre constitutes a irregular three dimensional network. Especially, the one running obliquely along the length of the body is long. For instance, in the bludders of the blue whale there are not a few which with the thickness of only about 5 cm. have a longitudinal fibre of 50 cm. long and a lateral fibre of 20 cm. long.

Hitherto, the collagens of whales have been used to obtain oil by the boiling process, which however has the disadvantage of giving a color and bad smell to the oil and dissolving the fibre and thus making it useless.

Now, according to the present invention it is possible to produce fibre of superior quality free from the above defect and also without damaging it mechanically as well as the oil and fat free from the above defect.

This invention is characterised by firstly pressing out oil from the fatty layers, tendons, etc. of whales, sharks, etc. by means of compressing the fibre with a rough compressing machine consisting of rollers of corrugated surfaces and a compressing machine consisting of rollers having network grooves; next compressing and broadening such net-work fibre slowly by a broadening and reeling rollers; opening it by the needles planted at the periphery of a rotating drum; scratching off the lateral fibre while the longitudinal ones is reeled in an orderly state or if necessary, scratching off the longitudinal and lateral fibres by the needles, treating the small quantities of fatty oil and elastin, which remain attached on them, with enzyme such as protease, lypase, etc. or an aqueous solution mixed with a small quantity of cow's milk and fermenting the same at below 40° C., removing the above foreign matters by washing them with a washing agent, pressing and elongating the fibres with a blunt knife edge, while the part of the fibre in contact with the back of the blade is compressed and expanded, so that the fibres are separated automatically, and finally treating them with a fixing agent such as formalin, chromium chloride, etc. to render them water-proof.

According to this invention, it is possible to easily remove useless substances without spoiling the fibres and also to produce wool or silk-like tenacious fibres from the residue remaining after oil is pressed out.

The present method may be divided into the following five steps:

(A) Compressing steps

In a compressing apparatus constituted by connecting one or more of each rough compressing machine consisting of rollers of corrugated surfaces and a compressing machine consisting of rollers having network grooves, the fatty layer or tendon of the whale, shark, cattle, etc. cut in suitable breadth is guided between the rollers of said rough pressing machine, regulating the space between the rollers suitably according to their thickness, so that they may be pressed roughly and the oil be pressed out. Next, their network tissue is compressed perfectly by guiding them between the rollers of said compressing machine. Thus, by this step excellent oil cannot only be obtained without the fatty layer slipping out, but also the fibre may be collected in a good condition without being spoiled by compressing.

(B) Opening step

The fibre as it is in a compressed and dried condition still has a three-dimensional network structure and is hardened, but becomes tenacious when kept in a slightly moist condition, namely, undried condition. In such condition it is fed between the broadening rollers to be compressed thin and broad. Next, supporting the fibres with a plate having an uneven end surface like a comb, the lateral fibres are scratched off and collected by the points of the needles which are planted on the surface of a rotating drum and next are transferred to the needles of the similar drum rotating in the opposite direction while the longitudinal fibres are pressed strongly by reeling rollers, as they are in a parallel state. If necessary, omitting the reeling rollers, the longitudinal and lat-

eral fibres may be scratched off by the points of the needles of the rotating drum.

When the fibre is easily separated from its knot owing to its moist condition and scratched off by the needle head while the longitudinal fibre is reeled by separate rollers, it is taken continuously by the rollers because of a dissolved glutinous substance. The lateral fibres scratched off by the needle heads are detached from the needle points and put at the appointed place, while the longitudinal long fibres directly receive the next separating step without the necessity of being arranged in order again.

Generally, the three dimensional network fibre as such is very hard to break and open by thrusting the needles. Moreover, it is pulled by the needles and elongated more narrow. Besides, as the needles must be thick and strong for that purpose, it is necessary to plant a small number of them in rows, maintaining a fairly wide space between them for the breadth of the fibre structure. As regards the result of the opening, the main part of the lateral fibres still remain attached on the longitudinal fibres, and it is a big task to put them in order. But if the fibres are compressed and broadened by the broadening rollers as in this invention, they become thin and broad without spoiling themselves, and as they become broad, more needles can be put in operation for the same size of the material. Also, as they become thin, they may be scratched and torn sufficiently by comparatively small needles with the smaller force. In short, they may be scratched by planting many small needles thickly on the rotating drum throughout its entire breadth. Moreover, they are scratched by the needle points in the grooves of a comb-teeth shaped resisting plate disposed near the supporting rollers, so they are opened perfectly without the disadvantage of the tissue being extended narrow. Also, the lateral fibres can be separated completely from the longitudinal fibres.

(C) Fermenting step

This is the step of treating the small quantities of fatty oil and elastin remaining attached on the fibre after the main part of the oil and elastin is pressed out, with enzyme such as protease, lypase, etc. or an aqueous solution of cow's milk, fermenting the same at below 40° C. and removing the foreign matters by washing them with a washing agent.

By this step ,the above undesirable matters are removed to make the fibre easily separable without spoiling it. When it is dried, it can be made into a soft condition.

(D) Separating step

The fibres of animals, for example, the whale and shark which are naturally long are stuck together by a glutinous sticky solution and form a bundle, and if they are separated by removing said solution completely with a chemical, they are damaged considerably.

Now, according to this invention, utilizing the elastic property of these fibres they are stroked with a blunt knife edge to broaden the stroked part, while the part in contact with the back of the blade is compressed and expanded, so that the fibres are automatically separated or placed in an easily-separable condition. If they are rubbed repeatedly with an edged tool provided at the periphery of a rotating drum while being delivered slowly with feeding rollers, the glutinous matter is taken away, thus making it possible to separate them. At the same time, their knots too are removed.

Thus, after finally stroking all the parts of the fibre except the part supported by the delivery rollers, reverse its direction and stroke it as before. Then, the knots of its head and root will be removed, making it fit as spinning fibre. Unlike those treated with a chemical, it may be separated perfectly retaining the original strength of the fibre.

(E) Water proof treatment

Since the fibre which has undergone the before-mentioned treatment is not water-proof as it is, it is subjected to water-proof treatment so that it is not hardened even when moistened and holds in molecules among the fibre therefore is light and helps the preservation of warmth (as cloths), furthermore, it can stand the subsequent operations sufficiently, for instance, dyeing, washing, etc. The accompanying drawings show an example of the embodiment of the apparatus suitable for carrying out the present process.

Figure 1 is a side view partly in section of a machine for compressing the fatty layers of marine animals such as the whale and shark or the tendons of the whale, shark and cattle;

Figure 2, its front view showing the front of a rough compressing roller;

Figure 3, a side view of the above roller partly in section;

Figure 4, an enlarged front view of the compressing roller of the compressing machine;

Figure 5, a cross sectional side view of an opening machine;

Figure 6, its plan;

Figure 7, a front view of an opening roller cut off along the line (VII)—(VII) of Figures 4 and 5;

Figure 8, a side view in longitudinal section of a separating machine and

Figure 9, its plan.

The following is the further explanation of each step of this invention with reference to the accompanying drawings:

In the drawings, A is a rough compressing machine consisting of a pair of upper and lower rollers 1 and 2 of corrugated surfaces; and B, a compressing machine consisting of a pair of upper and lower rollers (3) and (4) having network grooves.

These two machines A and B form a compressing machine, one or more of each of the above rough compressing machine and compressing machine are connected together. The rollers 1 and 2 are secured to the supports 9 of both sides by the bearings 7 and 8 of transversal shafts 5 and 6. The transversal shaft 6 is connected suitably to a prime mover by a gear 11. Also, gears 13 and 14 are connected. The bearing 7 is connected with a handle 24 by a worm bevel gear 16, a worm bevel gear 17 engaged with it, a vertical shaft 22, bevel gears 18 and 19 and a transversal shaft 23, so that it may be moved up and down suitably through a guide groove 10 by said handle 24 so as to regulate the space between the rollers 1 and 2 according to the thickness of the fatty layer or tendon of an animal to be fed between them. The rollers 3 and 4 are secured to the supports 29 of both sides by the bearings 27 and 28 of transversal shafts 25 and 26. The motion-transmitting device and the device for regulating the space between the rollers by a handle are substantially the same with those in the before-mentioned rough compressing machine A. The

rollers 3 and 4 have the rotating speed increased successively according to the degree of the elongation of said fatty layer and tendon.

Generally, the collagen and tendon of the whale are covered with oozing oil. Especially, the fatty layer is so thick that if it is fed between the rollers without any device the latter skid and consequently it is extremely difficult to compress it. Under the circumstances, manufacturers of whale oil have hitherto relied upon the boiling process, in which however the fibre is hydrolized by boiling and absorbed on the oil. Thus, the oil is not only spoiled, changing its color and having a bad smell owing to the putrification of the protein, but also the fibre inevitably becomes useless.

But in this apparatus, the fresh fatty layer and tendon are firstly fed between the rollers 1 and 2 of the rough compressing machine A at below 30° C. as they are long, while being delivered by a conveyor and are compressed roughly, travelling zigzaz, and after thus compressing them to some extent and pressing out the oil, they are again fed between the rollers 3 and 4 of the compressing machine B and then are compressed well, supporting them tightly with the network uneven surfaces of said rollers. In this way, it is not merely possible to press out about 50–75% of colorless and odorless oil of superior quality, but also to compress its network tissue. A fibre bundle consisting of many single fibres and a network tissue are hardened by the ordinary compression, for example, a hydraulic press, rendering the subsequent opening operation difficult and requiring much time for the operation. But if the operation is carried out to the last by using together the rough pressing machine A consisting of the rollers 1 and 2 of corrugated surfaces and the compressing machine B consisting of the rollers 3 and 4 of network grooves, the product may be obtained efficiently in a large quantity without the above apprehension, and if the raw material is treated suitably after the oil is pressed out, a network tissue can be obtained. By separating this tissue there is obtained a product which is tenacious and can preserve warmth and therefore is fit as spinning fibre. The oil pressed out is collected in a tank 30, from where it is stored in a reservoir 31.

By carrying out the opening and compressing steps continuously the efficiency may be further increased. The opening step is carried out by the opening machine shown in Figs. 5 and 7. After the oil is pressed out by the said compressing machine, the network tissue is fed to a broadening and reeling rollers at suitable intervals.

Delivering it out slowly, broadening it by compression with the broadening rollers and then supporting it with a plate of a saw teethed end surface, it is opened by the needles planted at the periphery of a relatively quickly rotating drum and the lateral fibres are scratched off by said needles, while the long longitudinal fibres are reeled by the reeling rollers as they are arranged in good order. Thus, it is possible to separate the longitudinal and lateral fibres from each other by a simple means. In some cases, the longitudinal fibres may be scratched off together with the lateral fibres by the needles of said rotating drum. In the drawings, C and E are reeling rollers; and D, a pair of broadening rollers, which receive motion from a pulley 41 by toothed wheels 35–40 through gears 32 and 34 and are rotated by a toothed wheel 43 engaged with the gear 34 provided with a rotating drum F which has a number of hook-shaped needles 42 planted at its periphery and also are moved in conjunction with another reeling roller G which is driven in conjunction with the pulley 41 by a toothed wheel 45 turned by the rotation of the gear 32 and an oppositely rotating drum K having a number of straight needles 44 at its periphery in a similar manner as F the rotating speed of said roller G being a little quicker than that of the broadening rollers D, while the speed of said rotating drums F and K is far quicker than theirs. The front face of the reeling roller E is provided at the end surface with a plate 46 having a saw-teethed end surface, so that by passing the point of each needle 42 of said rotating drum F through the recess of the saw-teethed part of the plate 46 the drum F may be rotated freely.

The network fibres of the whale, shark, etc. from which oil has been pressed out by a compressing machine are fed in somewhat moist condition to the reeling and broadening rollers C, E and D, when they are broadened right and left, while being compressed, and then the long longitudinal fibres are bent downward over the pointed part of the end of the plate 46 so as to be reeled slowly by said roller G. At the same time, by the rotation of the drum F the network fibres supported on the plate are partly pressed into the recesses of the plate by the points of the hook-shaped needles 212 and the lateral fibres are not only scratched off in turns by the heads of the needles 42, but also such scratched-off lateral fibres are detached by the needles 44 of the rotating drum K and released into a water tank 49 by the water jetted from the nozzle 48 of a water feed pipe 47 and collected there by a netting or the like. In this case, if necessary, omitting the above reeling roller G, the longitudinal and lateral fibres may be scratched off by the needles 42 and 44 of the rotating drums F and K alone and be collected similarly in the water tank 49. As the network fibre is broadened thin by the broadening roller, a comparatively large number of needles may be used according to its breadth to pierce its surface. Also, by supporting the fibres from under on the uneven surface of the plate, thus giving them resistance and pressing them into the recesses of the plate partially by the needles, the lateral fibres are scratched off, so that the network fibre may be opened easily and perfectly. The lateral fibres are not only separated from their knots, but also the longitudinal fibres which pass through the recesses of the plate are connected successively by their glutinous matter and reeled down all together by the roller G as they are arranged in good order.

Therefore, there is no fear of the fibres being broken because of opening. As according to this method the longitudinal and lateral fibres are separated from each other easily and the long longitudinal fibres may be collected as they are arranged in good order, the separating step may be carried out directly after.

By the way, the above rollers C, D and E can have the space between them regulated suitably by handles 50, 51 and 52 respectively.

The following is an explanation of the fermenting step:

After treating the collagens of the whale and shark or the tendons of the whale, shark and cattle by the first and second steps, the fibres which have small quantities of fatty oil and elastin remain attached on them are put into a

porcelain bottle or concrete tank, and after pouring water into them, enzym such as protease and lypase or a small quantity of cow's milk is added and then the fibres are left alone for 24 hours, whereupon elastin is almost completely fermented and decomposed. After squeezing out the lastin, they are washed with a washing agent, for instance, a washing agent consisting mainly of high grade alcohol and ester sulphate or Marseille soap and then is dried. Thus, said foreign matters are removed in a relatively short space of time and also the fibres are made tenacious and easily separable without being spoiled as when a strong acidic or alkoline solvent is employed. The above step may be applied with the same good effect to not only the collagen of the whale and shark, but also the tendons of the whale, shark and cattle and the tissues surrounding the sperm head oil of the sperm whale.

Next, the separating step is performed by the separating machine shown in Figures 8 and 9, in which **53** and **54** are the delivery rollers engaged at the teeth of their peripheries and rotated through the wheel of a pulley **64**.

One end of a bundle of the fibres obtained by opening said network fibres is inserted between said rollers **53** and **54** and a rotating drum **56** having knives **55** attached at its periphery at certain intervals is moved in conjunction with said rollers by gears **57**, **58** and **66**, thus delivering out said fibres slowly by the rollers **53** and **54** and stroking them pressingly against the curved face of a plate **61** with the blunt edges of the knives **55** of the rotating drum **56**. The fibres, as they are stroked, have the stroked part elongated, while the part in contact with the back of the blade is compressed and expanded, so that the glutinous matter is destroyed and consequently the fibres are separated automatically or given the condition easy to separate. In this way, the fibres are moved forward and stroked repeatedly by the knives, so that the glutinous matter is not only removed, but also the knots of the fibres are taken away simultaneously. Thus, after all the parts of the fibres except those held by the rollers are stroked, reverse their direction and stroke them as before, and then the knots at their heads, etc. will be all removed to make them slender from end to end. Therefore, they can be separated completely without being spoiled as when treated with a chemical. On this occasion, the rotating drum **56** is shifted forward and backward by the rotation of the handle **62** and the space between the rollers **53** and **54** is regulated by the handle **63**.

Lastly, the thus-treated fibres are rendered waterproof by treatment with a fixing agent such as formalin or chromium chloride. In this way, it is possible to obtain fibres, each several to 40 centimeters in length, a few to 30 M (Micron) in diameter with the extensibility 18, the strength 1 denier, the converted value 4 grams and an irregular section with air gaps and fit for the preservation of warmth.

The thus-produced fibres can be spun in a wet or dry condition in the same manner as the known ramir, flux, silk and wool.

According to the present invention, it is possible to obtain the wool-like fibre more tenacious than or as mollient as the silk and sultable as spinning fibre by treating the collagen of the fatty layers of the whale and shark, the tendon of the whale, shark, cattle, etc. or the residue of the tissues surrounding the sperm head oil of the sperm whale some of which have hitherto been considered useless and thus removing the trouble caused to them chemically and mechanically.

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