Oct. 9, 1945. L. C. PHARO 2,386,713

ASBESTOS TREATMENT

Filed Nov. 21, 1942 4 Sheets-Sheet 1

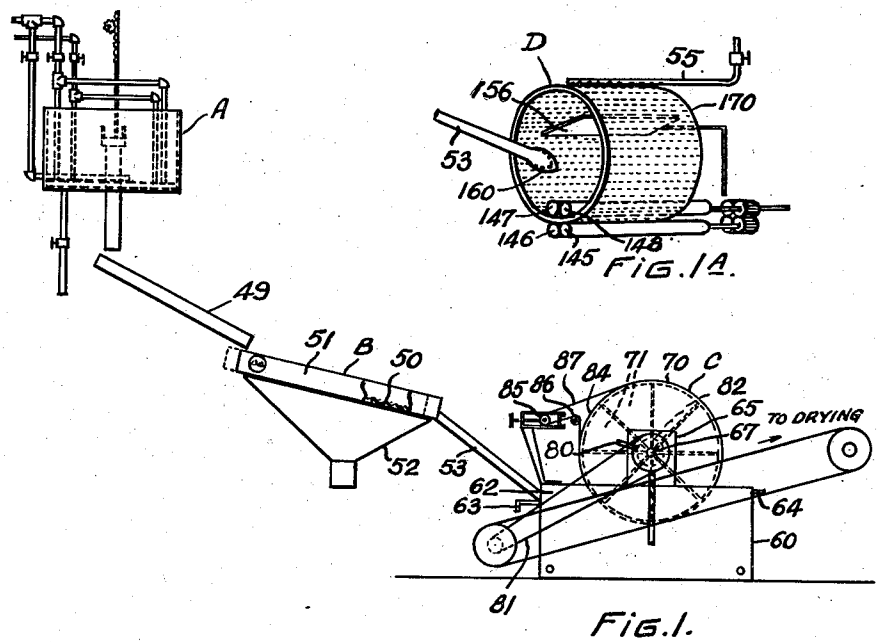


FIG. 1A.

FIG. 1.

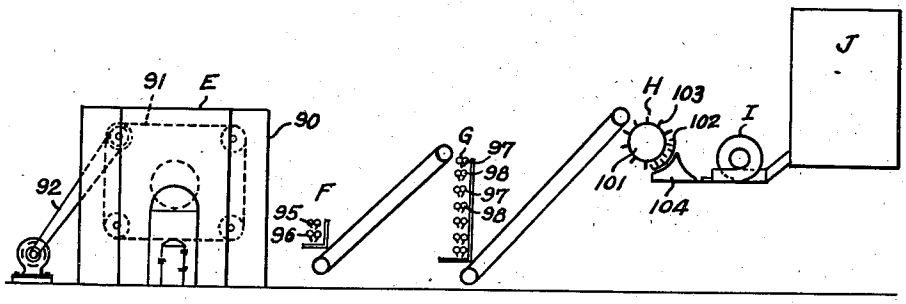


FIG. 2.

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ASBESTOS TREATMENT

Filed Nov. 21, 1942 4 Sheets-Sheet 2

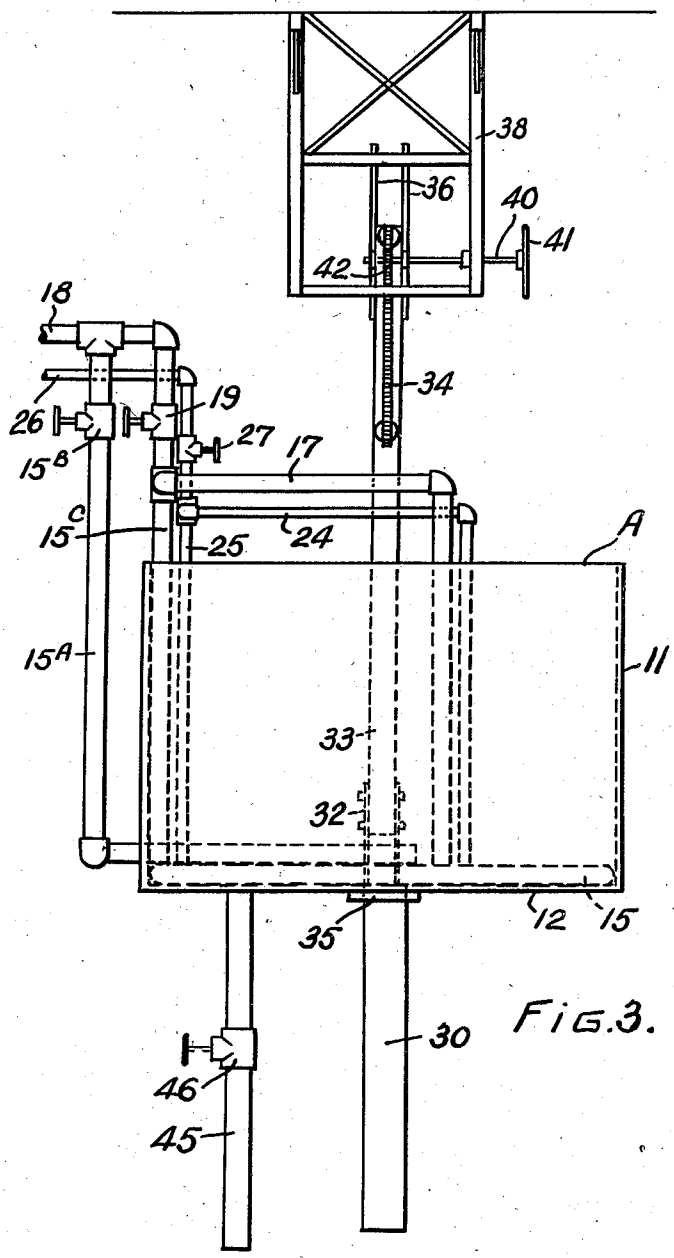


FIG. 3.

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ASBESTOS TREATMENT

Filed Nov. 21, 1942 4 Sheets-Sheet 3

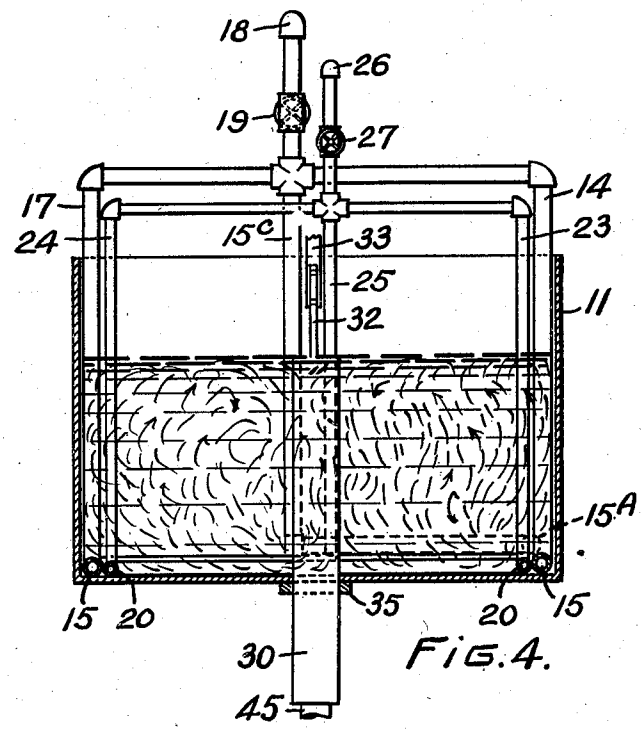


FIG. 4.

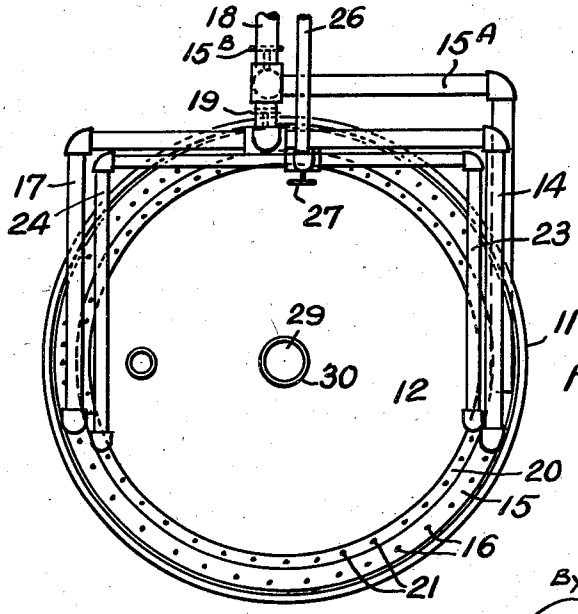


FIG. 5.

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ASBESTOS TREATMENT

Filed Nov. 21, 1942 4 Sheets-Sheet 4

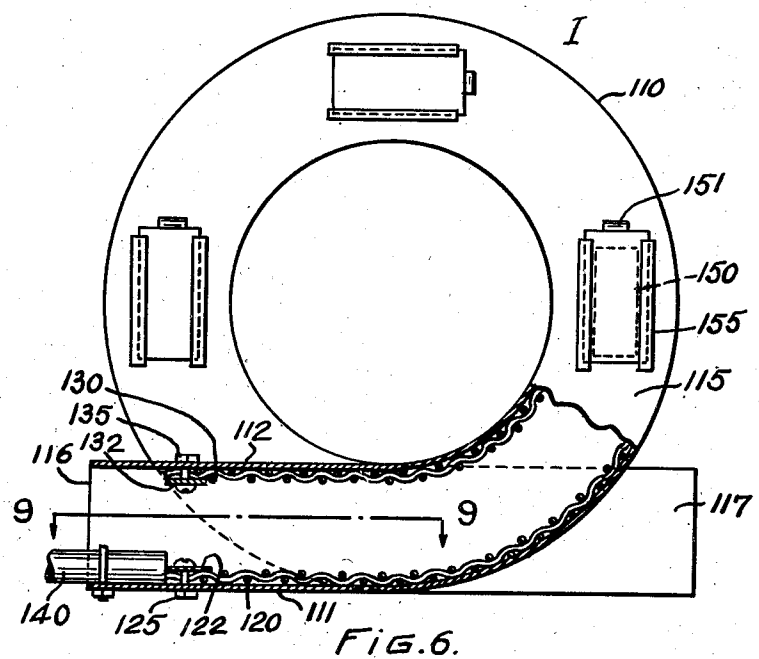


Fig. 6.

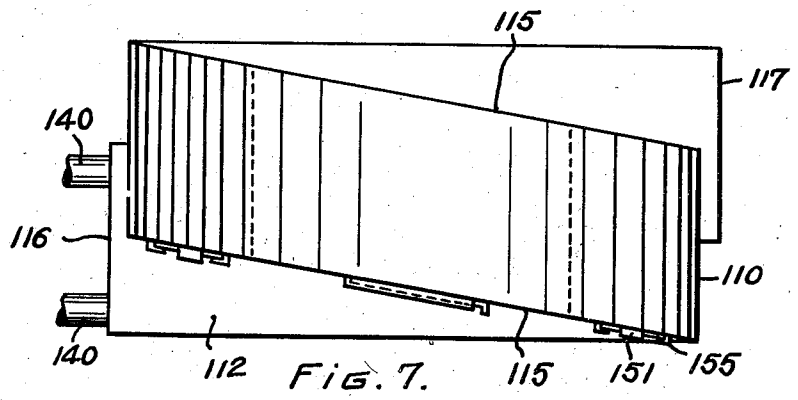


Fig. 7.

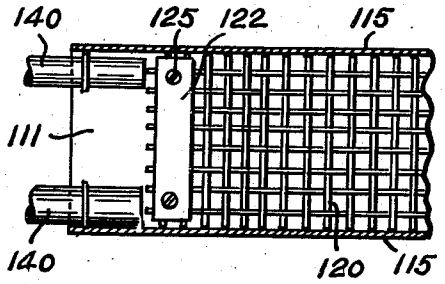


Fig. 8.

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Patented Oct. 9, 1945

2,386,713

UNITED STATES PATENT OFFICE

2,386,713

ASBESTOS TREATMENT

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Application November 21, 1942, Serial No. 466,522
In Great Britain February 10, 1942

9 Claims. (Cl. 19—66)

Introduction

This invention relates to the treatment of asbestos and more particularly to treatment for enhancing the spinning qualities of asbestos recovered from the ore by mechanical methods.

In order that the operative environment of the present invention be better understood there follows a brief description of asbestos recovery as practiced today. Reference is also made to the reference book "Chrysotile Asbestos in Canada" by James Gordon Ross, published by the Canadian Department of Mines.

According to current practice, asbestos ore is obtained by quarrying in the open cast system or by underground mining. The highest grade of the mineral, known as "crude" asbestos is removed from the ore by hand. "Crude" forms only about one-eighth of the yield of a Canadian chrysotile asbestos mine, the remainder being "milled" fiber, which must be recovered by mechanical means and with the treatment of which this application is primarily concerned. In the recovery of milled fiber, the ore must first be crushed. This involves several mechanical operations by which the rock is finally reduced to approximately 2½ inches. It is then dried to remove inherent moisture.

Milling includes further crushing, in a series of steps in which the rock is finally reduced to about ½ inch. As an incident to each of these steps, free fiber is removed to prevent injury in subsequent operations. The milled fiber is then bagged.

When the milled product is sold to the textile manufacturer, its price is considerably lower than that of crude fiber. The reason for the discrepancy in price is that in subsequent textile operations much less cotton need be added to crude asbestos than to milled fiber. Some cotton is necessary in all cases to give satisfactory textile qualities to the yarn.

The present invention results from the applicant's observation of a reason underlying the inferior textile qualities of milled fiber. The milling process, he found, results in an accumulation of dust upon the fibers, the dust acting as a lubricant to the individual fibers causing them to slip one over the other, thus preventing their forming a satisfactory yarn. From this observation came the thought of cleaning the fiber to rid it of the entrained dust. But, asbestos is a peculiar material which cannot be treated similarly to other fibers. For instance, previous attempts at wet treatment have resulted in the matting together of inseparable masses of fiber, a decrease in the staple length of the masses, incomplete fiberizing and other unsatisfactory conditions.

The present invention, therefore, relates to the solution of this problem and to a method in which asbestos fiber is treated to remove impurities, thereby enhancing its textile qualities, and to apparatus employed in carrying it out.

Objects

Having regard to the foregoing, it is a principal object of the present invention to provide a method of treatment whereby asbestos fiber may be rendered satisfactory for uses for which it has heretofore been thought necessary to use fiber of a higher grade.

It is a further object of the invention to provide a satisfactory method of cleaning asbestos fiber to fulfill the previous object.

A more specific object is to provide for washing asbestos masses and subsequently freeing the individual fibers from the masses to render the washed product suitable for textile use.

It is a further object to provide a method for improving the textile qualities of asbestos recovered by mechanical methods.

It is a still further object of the invention to provide convenient apparatus for carrying out the process of the invention.

The invention

These objects and others are accomplished according to a preferred embodiment of the invention, in a process in which milled asbestos is washed and scrubbed to rid it of dust, dried and fiberized to yield a commercial product having substantially the textile characteristics of crude fiber. The fiber, from which the rock has been removed by a usual milling method is first subjected to the washing step in which the dust is effectively removed. In the washing process in commercially applicable equipment, agitation of a particular nature is employed in order to achieve the desired cleansing action without tangling or roping the fibers, which is an expected incident to treating asbestos in water.

The fibers, freed of impurities, are then treated to remove the greater part of the water and compacted into thin sheets suitable for drying. The sheets are dried. After drying, the sheets are treated in a step which provides for their thorough working so that the asbestos is fiberized further without injury to the fibers. The fiberized asbestos is then subjected to a special fluffing operation in which it is blown against a resistance

element, so as to liberate the fibers without injury.

This treatment is contrary to the general trade conception that asbestos could not be wetted and then dried satisfactorily to yield a commercially acceptable product. This conception has, up to now, resulted in the general rejection of proposals for wet concentration as opposed to the usual methods.

Detailed description

The invention will be understood more specifically by reference to the following detailed description illustrated by the accompanying drawings showing preferred equipment used in carrying out a specific embodiment of the invention and in which:

Figures 1 and 2 are diagrammatic illustrations showing the equipment employed in carrying out the preferred process.

Figure 1*a* is a diagrammatic illustration of an alternative piece of equipment for compacting the washed fiber.

Figure 3 is a side elevation on a larger scale of the washing apparatus.

Figure 4 is a vertical cross section through the apparatus shown in Figure 3.

Figure 5 is a plan view of the apparatus shown in Figures 3 and 4.

Figure 6 is a side elevation partly in section showing the fluffing apparatus according to this preferred form of the invention.

Figure 7 is a plan view of the apparatus shown in Figure 6.

Figure 8 is a fragmentary cross section along the line 8—8 of Figure 6 illustrating the manner of attachment of the resistance screen.

Referring in more detail to the drawings, A represents an apparatus for washing the fiber after the ore has been crushed; B is equipment for partially dewatering the masses of fiber leaving the washing apparatus A; C is a filter used for compacting and dewatering the fibers; D is an alternative compacting apparatus which may be used in place of the filter C; E is a drying apparatus for drying the fiber leaving the filter C; F is a mechanism for partially disintegrating the sheets of compacted fiber leaving the apparatus E; G is a fiberizing apparatus for fiberizing the compacted sheets after drying; H is a threshing device for further disintegrating the masses; I is a fluffing or teasing apparatus for liberating the fibers before use in textile operations; J is a bagging room.

Washing apparatus

The washing apparatus A is made up of a large circular tank or bath having sides 11 and a bottom 12. Encircling the bottom of the tank, adjacent to the side is a water supply pipe 15 having openings or jets 16 through which the water is injected into the tank. Pipes 14, 15*c* and 17 connect the pipe 15 to a main 18 leading from a suitable source of water supply. The line 18 is controlled by a valve 19. Encircling the bottom of the tank inside the water line 15 is an air supply pipe 20 provided with jets 21 through which air is supplied to the tank at marginal points thereof for the purposes of agitation as will be described. The pipe 20 is connected by pipes 23, 24 and 25 by a supply line 26 leading from a compressed air supply. The line 26 is controlled by a valve 27. For the purpose of giving the water in the tank a circular movement there is also provided a water supply pipe 15*a* also leading from the supply line 18. The pipe 15*a* is controlled by a valve 15*b*.

The bottom 12 includes a circular opening 29. In this opening is fitted for vertical movement a discharge pipe 30. The pipe 30 is snugly fitted to the opening by a gland 35 so that leakage is minimized. The top of the pipe 30 is connected by means of a bracket 32 to a slider bar 33. To the upper end of the bar 33 is fastened a rack 34. The bar is slideable in a guideway 36 mounted in a frame 38 suspended over the apparatus A. Also mounted in the frame 38 is a horizontal shaft 40 operated by a hand wheel 41. On the inner end of the shaft 40 is a pinion gear 42 adapted to engage the rack 34. In this way the pipe 30 may be raised and lowered by operating the hand wheel 41. The tank is also provided with a drain pipe 45 controlled by a valve 46. A cylindrical baffle may be employed about the top of the pipe 30 so as to prevent asbestos from entering prematurely the top of the pipe.

The dewatering apparatus B is made up of a vibrating screen 50 having sides 51, a discharge funnel 52 for the water from the screen, and a discharge spout 53 for the wet fiber leaving the screen. Masses of fiber reach the device B by means of a chute 49 arranged between these two mechanisms.

Filter

The filter C is of conventional design for filters used to compact and de-water fibrous materials and consists of a frame 60 in which is mounted a water tank 62 capable of receiving the asbestos. The tank is equipped with an inlet 63 and an overflow outlet 64. The inlet is adjacent to the chute 53 leading from the dewatering device.

Mounted on the frame 60 are brackets 65 equipped to receive bearings 67 capable of vertical adjustment. In the bearings 67 are journalled the ends of a horizontal shaft carrying the filter cylinder 70. The cylinder is made up of a plurality of separate sections 71 communicating at their inner ends with a valve system 82. The surface of the cylinder is provided with a screen or other suitable filter medium 84. A suitable source 80 of exhaust pressure is connected with the valve system 82 so that suction is applied to the surface of the cylinder separately at the individual sections as will be understood by one familiar with the art. The arrangement is such that suction is applied to the sections just as they emerge from the water and ceases to be applied in the region where asbestos is removed from the surface of the cylinder as will be described.

Extending about the filter and about take-off and tensioning rolls 85 and 86 are a number of continuous parallel strings or bands 87 forming a web adapted to remove the asbestos masses from the filter as the cylinder rotates. A suitable drive 81 is provided for rotating the cylinder 70.

An alternative form of device suitable for compacting and de-watering the washed asbestos is indicated as D. This device includes a spout 160 to receive the fiber from the spout 53. Below the spout 160 are four cooperating ringer rolls 145 and 146, 147 and 148. Between the pairs of rolls 145 and 146, 147 and 148 there is a cylindrical perforated plate or screen 170 adapted to receive the fiber from the spout 160. The pair of rolls 147, 148 is rotatable counter-clockwise

(in the figure) and the pair 145 and 146 clockwise, by any suitable mechanism (not shown). Rotation of the rolls rotates the plate 170. Compressed air nozzles 55 receiving compressed air from a suitable source are arranged to blow on the upper side of the screen 170 through the perforations and thus to remove the fiber sheet which is formed on the screen as it is conveyed upwards from the rolls. A plate 156 is arranged to receive the sheet from the screen. The asbestos may be recovered from the plate 156 by hand or by a suitable mechanism.

Drying apparatus

The drying apparatus indicated in the drawings consists of an enclosure or housing 90 within which the air is capable of being conditioned and heated. An endless conveyer 91 is provided for carrying containers for the asbestos masses continuously through the oven. A drive 92 is provided to operate the conveyer at any desired speed.

The separating apparatus F consists of a pair of rolls 95 and 96 respectively. The bottom rolls operate faster than the top ones, whereby the sheets of fiber are pulled apart into smaller sheets with no substantial reduction of the fibers.

The apparatus G consists of a series of pairs of rolls operating at the same or at slightly different speeds. Alternative pairs of rolls 97 and 98 are grooved in different directions. In other words, in one pair the surface grooves run axially and in the other they run circumferentially. The rolls of respective pairs interlock. An apparatus of this type is described in U. S. Patent No. 2,219,077, October 22, 1940.

The device H is a threshing machine of a conventional type in which projections 103 on a drum 101 cooperate with projections 102 on a stationary member 104 providing a threshing action.

Fluffing apparatus

The device I consists of a spiral tubular casing 110 made preferably of suitable sheet material. This casing includes a floor 111, a ceiling 112 and side walls 115. In the particular embodiment shown, the casing 110 is provided with an entrance 116 and a discharge opening 117. Intermediate these openings the casing is looped in a spiral.

The floor 111 is surfaced with a coarse mesh wire screen 120. This screen is held in place by brackets 122 secured to the floor 111 by nuts and bolts 125. The ceiling 112 is similarly surfaced with a screen 130 held in place by a bracket 132, and nuts and bolts 135.

Adjacent the entrance 116 is a pair of air supply pipes 140 controlled by a valve (not shown). These pipes are connected with a suitable source of air supply capable of giving an air pressure at the outlet of the pipes of about 100 lbs. per square inch. In this particular apparatus the pipe is of internal diameter of about ½ inch.

One of the sides 115 is provided with openings giving access to the inside of the casing. These openings are provided with sliding doors 151 fitting snugly in suitable guideways 155.

The process

A process of treating the asbestos in this preferred apparatus according to one embodiment of the invention will now be described.

The asbestos is first concentrated or milled by usual methods. Generally the rock is separated from the asbestos by dry methods during which the asbestos is partly fiberized and is in the form of substantially dry masses of fiber carrying, as the applicant has discovered, harmful quantities of entrained dust. The method may, alternatively, be used to supplement the treatment of asbestos concentrated by wet methods.

Washing

The tank is first filled with water. The pipe 30 is adjusted so that its top end or entrance is at a height to bring the water to a desired depth without overflowing, for instance as indicated in Figure 4.

Masses of asbestos are then suitably fed into the water. These masses are allowed to soak for a period sufficient to soften the dust adhering to the fibers. Then, the compressed air supply is turned on, causing air bubbles to rise from the jets 21. This results in agitation of the water in a circular motion from the lower margin of the tank upwards and then inwards towards the outlet pipe 30. The water feed is continued so that a slight overflow takes place allowing dirty water to escape. Several water and air inlets are employed at various points about the circumference of the tank, so that the pressure is more or less uniform at various points. The agitation is continued for a period until the water becomes fairly clear. Then the pipe 30 is lowered gradually and the asbestos allowed to escape through the discharge where it passes on down the chute 49 to the next step in the treatment. Alternatively, the water may be removed and fresh water supplied several times before the asbestos itself is removed. Supplying water through the pipe 15a causes a circular movement of the asbestos about the tank which has been found beneficial in the treatment. The restricted outlet afforded by the pipe 30 minimizes the premature escape of asbestos, without objectionable blocking which might take place where a screen or device is employed.

The manner of washing the fiber is important. Agitation of the contents of the tank as described, prevents swirling of the water in eddies or any other turbulent motion which might cause tangling of the fiber. Any tangling must be meticulously avoided or the fiber would tend to coil up into masses which cannot be disentangled without injury to the fiber. This is one of the difficulties always experienced up to now in the wet treatment of asbestos and is sometimes referred to as "roping."

The particular type of agitation, preferably by injecting compressed air through the water and floating fiber, results in a substantially non-turbulent scrubbing action in which the individual fibers and masses of fiber are rubbed together and the entrained dust or sludge, as it becomes when wet, is removed. Unless this sludge is removed, the fiber once wet, on being allowed to dry, has a tendency to cake or mat, the film of dust on the fibers forming a bond between them not unlike Portland cement or some of the clays used in making bricks.

Dewatering and sheeting

The masses of fiber pass on to the vibrating screen. Vibration of the screen 50 causes the water to flow into the hopper 52 while the asbestos, partially dewatered, passes on down the chute 53 into the filter.

The masses reaching the filter are immersed

in the tank 62. The action of the filter in which the cylinder rotates from left to right is to cause the fibers to be taken up on the surface of the cylinder by suction. The masses are thus compacted, the water removed and eventually they are stripped by the belt 87, ready for the next operation. While the filter is of conventional design its use in connection with asbestos in the manner described is thought to be novel.

Alternatively the asbestos may be compacted and dewatered by the device D. Where this device is employed the fiber should be discharged through the spout 160 onto the surface of the rotating screen 170. As the screen rotates the sheet mass of asbestos fiber passes between the top pairs of rolls and the screen which is forced against the upper rolls by the lower ones. The asbestos comes out on the other side of the rolls compacted onto the screen in the form of a thin sheet which adheres to the screen to be carried to a position where it is blown by the compressed air nozzles from the screen onto the plate 56.

The compacting of the fiber into thin sheets without forming an inseparable tangled mass is also important. It is possible to dry thin sheets whereas thicker masses would be almost impossible to dry. At the same time masses tangled in such a way that they could not be disentangled without rupturing the fiber would defeat the purpose of the invention. It is thought that the particular manner of compacting and dewatering the mass is important.

The compacted masses are then dried. This may be performed in any convenient manner in the apparatus E. The thin masses resulting from the compacting and dewatering operations are placed in trays suspended from the conveyer 91 and are moved slowly through the heating chamber 90 for a time effective to dry them to the desired extent. Since the masses are compacted and are thus relatively thin, they dry quite rapidly.

Fiber liberation—fiberizing

The masses are then partially broken up by the action of the rolls 95 and 96 of the apparatus F. They are then conveyed to the fiberizing apparatus G where they are fiberized according to the method described in U. S. Patent No. 2,219,077, October 22, 1940. The action of the rolls in the apparatus G is to flex the compacted masses or sheets backwards and forwards in different directions. It should be noted, however, that the sheets are always supported by the roll surfaces during flexure. This contrasts with the action of a beating machine where masses of fiber are subjected to violent blows while unsupported. The fiberized masses are then subjected to the action of the threshing machine H whence they pass to the fluffer I.

Fluffing

The compressed air is turned on by the control valve setting up high pressure at the entrance 116.

The asbestos masses which have been at least partially fiberized are fed in a suitable manner and are immediately taken up by the air stream and forced through the casing at high speed. In their passage through the casing they impinge on the resistance elements or screens 120 and 130 and are thus subjected to a disintegrating action. The resistance of the screens is, however, only partial and the air-borne masses are free to leave the screens and to move further through the passage formed in the casing. Hence breakage of individual fibers is minimized.

In the present process the product reaching the discharge 117 is very fluffy. The individual fibers are liberated completely for practical purposes and in excellent conditions for textile use. The general practice is to pass them through preliminary textile operations before they are actually spun.

The method of fluffing the asbestos masses to liberate the fibers by projecting them under air pressure against a resistance element is thought to be novel as is the combination of steps consisting of first partially fiberizing the dried masses by flexing them back and forth in different directions while supported by the roll surfaces and then subjecting them to the fluffing operation.

The nature of fiberizing and fluffing steps is important. Too much emphasis cannot be laid on the fact that asbestos must be handled carefully so as to liberate the fibers without breaking them. This is particularly true of the sheets coming from the drier E. In these sheets the fibers are laid at various angles to each other and therefore any rapid beating or chopping action against the sheets as by the beaters or arms of a grader or jumbo machine rotating at a high speed in cutting the sheets up will break up the long fibers of the masses severely damaging its qualities for textile uses. In the applicant's method, the sheets are held between two surfaces (the intermeshing surfaces of the rolls) while they are thoroughly flexed in transverse directions. There is no chance of their receiving any rapid chopping blows which would rupture the fibers. The fluffing or "tearing" action of the applicant's process also departs from any beating action on the fiber masses. They are blown under relatively heavy air pressure against the undulating or ribbed surface presented by the coarse screen lining of the fluffer tube. At all times, the fibers are free to leave the screen against which they have struck with a glancing blow as the air pressure carries them forward. At no time is any chopping action at right angles to the fiber as experienced in a jumbo or grader employed. Any such chopping action would be most destructive to the long fibers, when the asbestos is in the form of sheets formed under pressure when the material is wet.

It must also be remembered that the ability to fiberize and fluff the masses of fiber depends largely on the condition of these masses as they come from previous treatment. If the masses have not been suitably cleaned, the fibers will still contain the dried sludge tending to cement them together, thus rendering liberation difficult. Moreover, no amount of fiberizing will result in the improvement of the spinning qualities as contemplated by the applicant.

Advantages

The procedures outlined offer great advantages to the asbestos art. Milled fiber can be cleaned and thus greatly improved in textile qualities. Asbestos once wetted can now be treated to render it suitable for making high grade yarn. The use of the present invention may render processes of wet concentration feasible in producing a high grade textile fiber where heretofore they have been considered impractical.

These results are as surprising as they are important, for a way of improving the textile qualities of milled asbestos fiber had long evaded those skilled in the art as had the ability to

liberate the fibers of wetted masses of milled asbestos satisfactorily for spinning purposes.

The resulting fiber

The fiber resulting from this process has excellent spinning qualities. The major portion of impurities such as sand and dust which might impair its textile qualities are effectively and thoroughly removed; any free iron content is reduced. The treatment is such that the fibers are not injured nor are they entangled or otherwise held together to prevent their being subjected to textile operations. In fact, the fiber leaving the fluffing apparatus can be made into yarn having substantially equal spinning qualities to that made from a similar staple crude fiber, that is, it can be spun with the small addition of cotton used in crude fiber. In view of the current conception that milled fiber cannot be used for spinning without the addition of a large quantity of cotton, this is a new and unexpected development in the asbestos art.

Examples

In order that the effectiveness of the present method of asbestos treatment may be further explained actual examples will be given. It is to be understood that these examples are not to be taken as limiting.

Example I

A number of batches of chrysotile asbestos from a large Canadian mine at Thetford Mines, Quebec, were treated substantially as described above and according to the figures given in the table below. Each batch was immersed in a tank corresponding in design to the tank 11, in which it was soaked and scrubbed for about 10 minutes. It was subsequently dewatered and compacted on the filter. It was removed from the filter and dried for about 70 minutes, at an average temperature of about 350° F. It was then passed through the fiberizing machine as herein described under spring pressure and fluffed at an air pressure of approximately 100 lbs. per square inch in a fluffer corresponding substantially to I. After fluffing, the masses were pooled periodically and bagged. The aggregate amount of asbestos fed to the tank 11 and the amount eventually bagged is shown in the following table, the remainder being the loss in treatment.

Table I

Amount of asbestos fed	13 tons 700 lbs.
Amount recovered from process	11 tons 160 lbs.
Amount lost in treatment	2 tons 540 lbs.

The loss is made up principally of dust and a small proportion of other losses such as "tramp" iron and spicules of fiberized asbestos. The spicules were collected and re-used.

Example II

In order to show the negligible reduction in staple length and other characteristics from treatment according to the invention, the following procedure was followed.

Samples were taken of the fiber treated as in Example I. These were subjected to the Quebec Standard test, the nature of which is clearly set out in "Chrysotile Asbestos in Canada," 1931, page 49. This test is made on the machine known as the standard testing machine of the following description:

The machine consists of a nest of four wooden boxes, measuring 24½ by 14¾ inches and 3½ inches in depth. The boxes, which are superposed one above the other, are numbered from the top down 1, 2, 3 and 4. The bottoms of boxes Nos. 1, 2 and 3 are made of metallic screen of the following specifications: Box No. 1: ½ inch opening, diameter of wire, 0.105 inch. Box No. 2: 4-mesh wire, 0.063 inch. Box No. 3: 10-mesh wire, 0.047 inch. Box No. 4 is a receptacle for the fines which fall through the three other boxes. The nest of four boxes or trays rests on a table to which an eccentric with a throw of $\frac{3}{32}$ inch gives a movement of $1\frac{9}{16}$ inch travel. To make a test, 16 ounces of asbestos is put on the top tray which is covered. The machine is run at the rate of 300 R. P. M. at the shaft of the eccentric, and by means of an automatic device, this is kept going for exactly two minutes, giving the nest a horizontal shaking movement. At the end of this time the asbestos which remains on each tray is weighed. This gives the grades of the asbestos fiber; the longest fiber naturally stays on the top tray, whereas the shorter fiber, according to its length, remains on screens 2 and 3 or drops into the pan or lowest tray. The more fiber retained on the first screen and the less fiber in the pan, the higher the grade and therefore the greater its value. If for instance a customer buys spinning fiber of the specification 4–7–4–1, it means that in a sample of 16 ounces, representing the average of the lot shipped, 4 ounces will remain on the top screen, 7 on the second, 4 on the third and finally 1 ounce will go through all the screens into the pan. He will evidently pay more for this material than for paper stock testing 0–0–10–6. This indicates that out of 16 ounces tested, nothing is retained on the first two screens, 10 ounces remain on the third and 6 ounces go through the latter into the pan. It is evident that the figures of the test represent the proportion in ounces of the different lengths of fiber in a pound of asbestos.

During the mill-run, a sample of each grade is taken every half-hour, both at the grading screens and at the point of bagging. As exact uniformity of grading cannot be secured, owing to the variable nature of the material coming from the pit, an allowance is made in the requirements of the test, the mill test showing a higher percentage in the upper test boxes than called for by market tests. As a general rule, the purchaser is delivered a fiber running higher on test than specified in his contract.

Several pounds of asbestos treated according to Example I were run through the standard testing machine and the results assayed. Subsequently, several samples of No. 2 crude fiber were put into the machine and the results assayed. The results were as follows, in terms of the percentage of the starting fiber which remained on the first and second boxes of the testing machine.

	Per cent
No. 2 crude, about	91
Fiber treated according to Example I, about	92

The treated fiber thus exhibited slightly better test results than the No. 2 crude, according to the Quebec Standard test which is the accepted trade measurement of grade.

Example III

Based on its spinning qualities, all the treated fiber of Example I was sold to the textile trade at a price of $330.00 (Canadian, May 1942) per ton, approximately $300.00 U. S. funds (May

1942) or at the equivalent price of No. 2 crude fiber. Excellent reports were received as to its textile qualities.

Example IV

Sample lots of the fiber treated in accordance with Example I were subjected to "opening." This is a preliminary treatment before textile use. The shrinkage was about 11.9% by weight. This compares with the normal shrinkage for "opening" No. 2 crude fiber of about 12%.

Example V

A batch of asbestos ore was milled by dry methods. The milled fiber was subjected to treatment as in Example I and the treated fiber recovered. It was then subjected to preliminary textile operations in which it was mixed with about 6% cotton. Yarn A was made from the asbestos-cotton mixture.

A batch of No. 2 crude fiber was recovered and fiberized by ordinary methods. It was subjected to preliminary textile operations in which it was mixed with about 6% cotton. The mixture of crude fiber and cotton was made into yarn B.

The yarns A and B were spun on a spinning machine. The yarn A was observed to have substantially equal textile qualities to yarn B.

The procedures and results described make it evident that milled fiber treated by the present process is the equivalent in textile qualities of No. 2 crude fiber. The potential textile qualities of the milled fiber are improved. Dust up to the amount of about 17% by weight of the fiber and which would normally impair the textile qualities is removed. The fiber length is preserved since the batches of the milled fiber referred to in the examples retain a fiber length substantially equivalent to No. 2 crude as determined by the "Quebec Standard test." In other words, the treatment is successful in removing the undesirable content of the milled fiber masses without having the expected undesirable effect of causing inseparable matted masses, which could not be disintegrated without reducing the fiber length. In brief, the fiber length is maintained substantially at the potential for the particular milled fiber being treated.

The treated milled fiber has substantially the textile qualities of No. 2 crude fiber and sells at about the same price. Only about 5 to about 7% cotton need be added to the treated fiber for spinning. Previously, milled fiber required up to about 18 or 20% of cotton to impart satisfactory spinning qualities to the roving.

The invention has been described specifically as applied to milled fiber. It will be understood that in its broader aspects, the process might be applied to cleaning and otherwise improving fiber which has not actually been milled. Also, some of the process steps as specifically described may be modified by the substitution of equivalents, provided, of course, they fall within the scope of the following claims. Water has been specified as the washing medium as this is the most convenient liquid known for the purpose. Any other suitable washing medium could be used without altering the spirit of the invention.

While chrysotile asbestos has been dealt with in this specification because this is the type of asbestos occurring in Canada it will be understood that various other types of asbestos may also be treated by this method, for instance amphibole, crocydolite, etc. The term "asbestos" is, therefore, used in a generic sense.

It will be understood that, without departing from the spirit of the invention or the scope of the claims, various modifications may be made in the specific expedients described. The latter are illustrative only and not offered in a restricting sense, it being desired that only such limitations shall be placed thereon as may be required by the state of the prior art.

The sub-titles used throughout the specification are merely to simplify reference thereto and should otherwise be disregarded.

I claim:

1. A process of treating milled asbestos fiber, comprising, scrubbing masses of the fiber with water effectively to remove entrained dust without roping the fibers, compacting said masses into sheets, drying the sheets, fiberizing the sheets by subjecting them to flexure in various directions while partially supported, and liberating the fibers from the partially fiberized sheets by the action upon them of compressed air without substantially reducing the staple length thereof, whereby there is produced a cleaned fiber having substantially the potential textile qualities of the starting fiber.

2. A method of treating asbestos fiber containing dust, comprising, washing masses of fiber to remove the dust without roping the fibers, dewatering and drying the washed masses to form sheets, fiberizing the sheets by flexing them backwards and forwards while supported, and blowing the fiberized sheets against a resistance element whereby individual fibers are liberated therefrom without substantially reducing the staple length of the fiber.

3. In the treatment of asbestos wherein masses of asbestos fiber are scrubbed in a wet state, the masses are formed into thin sheets, subjecting the sheets to flexure alternatively in transverse directions while supported between opposed surfaces whereby the sheets are completely fiberized, and blowing the sheets with high pressure air against a resistance element to liberate the fibers.

4. An apparatus for washing asbestos fibers, comprising in combination, a substantially cylindrical tank having sides and a floor and adapted to contain water, a centrally arranged discharge opening in said floor, a discharge pipe adapted to fit in said opening for vertical movement, means for moving said discharge pipe in a vertical direction whereby it may be set to maintain the water in the tank at a predetermined level and may be lowered to allow water and asbestos to escape from the tank, a water supply pipe encircling the bottom of the tank substantially at the margins thereof, a plurality of discharge openings in said pipe constituting jets arranged to supply water in a substantially vertical direction at a number of points about the margin of the tank, an air pipe encircling the bottom of the tank adjacent the margins thereof, openings in said air pipe constituting jets for the injection of air adjacent the bottom of the tank in a substantially vertical direction thereby to cause non-turbulent circulation of the water away from said openings upwards and inwards towards the center of the tank, means for supplying water to the water pipe and means for supplying air to the air pipe, means for controlling the water supply, and means for controlling the air supply.

5. An apparatus as claimed in claim 4 wherein means is provided for injecting water into the tank adjacent the margins thereof in a substantially horizontal direction whereby there is

caused circulation of the water about the tank in a horizontal direction.

6. In a process of treating asbestos obtained by dry milling asbestos ore wherein the rock is crushed and the asbestos fibers of spinning grade are removed therefrom containing dust in amount to impair their textile qualities, the steps of washing said fibers with water and washing out the dust without roping the fibers, dewatering the washed substantially dust-free mass, drying the same, working the dried mass to fiberize the same, and fluffing the fiberized mass to separate the fibers from each other without substantially reducing the staple length thereof, whereby there is produced a cleaned fiber having substantially the potential textile qualities of the starting fibers.

7. In a process according to claim 6 wherein the washing step comprises immersing the fibers in a bath of water, injecting air into the bath adjacent the bottom thereof to cause non-turbulent circulation of the water whereby the asbestos is scrubbed.

8. In a process according to claim 6 wherein the working step comprises subjecting the fibrous mass to flexure in various directions while partially supported.

9. In a process according to claim 6 wherein the fluffing step comprises subjecting the dried fiberized mass to high pressure air.

LEE C. PHARO.

Certificate of Correction

Patent No. 2,386,713. October 9, 1945.

LEE C. PHARO

It is hereby certified that error appears in the above numbered patent requiring correction as follows: In the heading to the printed specification, line 7, foreign filing date, for "In Great Britain February 10, 1942" read *In Canada February 10, 1942*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of September, A. D. 1947.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.