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DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method of Opening Up Fibrous Bundles of Crude Asbestos Separated from the Source Rock

I, KARL ADOLF OESTERHELD, of German Nationality, residing at Luthe near Wunstorf/Hannover, Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of opening up fibrous bundles of crude asbestos separated from the source rock, in which the bundles of fibres are mixed with a liquid and fed through between rubbing surfaces.

The opening up of crude asbestos, the individual fibres of which hang together in bundles, was hitherto carried out in pug mills, beater mills, hollow mills, centrifugal mills, so-called disintegrators. Although the asbestos material is subject to dry and thus robust treatment in the known opening apparatus, whereby the fibres are destroyed and shortened to a great extent, it is not possible to open up the fibre bundles to such an extent that the fibres are completely separated from each other.

It is also known to mix the fibre bundles with a liquid and subsequently subject them to a treatment effected by centrifugal rollers, grinders, pebble mills or hollander type beaters but a fully satisfactory degree of opening up the fibres is not achieved by this method, either, because owing to the absence of a closed guide the asbestos material is not so vigorously and frequently bent in continually varying directions as is necessary for completely loosening from the fibre bundles individual fibres sticking together over their whole length.

If the crude asbestos treated in the manner described above and the products made therefrom are carefully examined it will be found that the asbestos fibres still hang together in bundles. This fact, which considerably impairs the strength and uniformity of the structure of the asbestos cement product, is due to insufficient opening up of the crude asbestos material.

[Price 4s. 6d.]

The object of the present invention is to attain the complete opening up of the crude fibrous asbestos material without acting on the asbestos fibres still more vigorously than has been hitherto the case by the known methods, for this would increase the amount of damaged and destroyed asbestos fibres.

The problem of completely opening up the clustering or bundle-like adhering crude fibrous material separated from the source rock and mixed with a liquid is solved by the present invention in that over a long path formed by the rubbing surfaces and extending helically or according to a spiral space curve and having a length amounting to a multiple of the greatest fibre length, the fibre-liquid mixture is forced through between the rubbing surfaces with controllable high hydraulic pressure so that the fibres are pulled or squeezed in constantly varying directions by being continually bent transversely of their longitudinal extension.

To the invention as well as to the result obtained thereby it is material that the bundle-like adhering fibrous material be subjected to a vigorous rubbing action while simultaneously bending it a number of times in different directions by forcing it with high hydraulic pressure through a long closed feed channel formed by the rubbing surfaces. Practice has shown that it is possible in this way to increase the volume of a certain quantity of crude asbestos material to double its bulk or to reduce the weight by unit of volume to about half that attainable with the hitherto customary methods of opening up crude fibrous asbestos.

The fibre material opened up by the proposed method of the invention represents an absolutely uniformly loosened or opened up fibrous mass which, owing to exceptionally high capability of the fibres felting or becoming matted, corresponds to the ideal state of the fibre material required for producing

articles from asbestos cement and which is moreover also excellently suitable for the production of asbestos spun products and asbestos boards.

5 A test of the asbestos fibres opened up by the novel method, for preparing articles from asbestos cement has unexpectedly shown that it has now become possible to make asbestos cement products which comply with or even
10 exceed the strength factors prescribed by international standards for asbestos cement products without adding longer asbestos fibres, that is, solely from the asbestos fibres prepared according to the invention which are of
15 inferior quality. This means an extraordinarily great technical advance for the asbestos cement industry in that, owing to the saving in expensive long-fibred asbestos material, the costs of production are considerably reduced and in
20 addition the final products are far more homogeneous than those which were produced from a mixture of long, medium and short-fibred asbestos material.

It is generally known in the asbestos working industry that when dressing crude asbestos the place of origin of the raw material, which is primarily in Russia, Canada, Africa, Australia, Cyprus and Italy, must be taken into consideration because the chemical and crystal-
30 line structure, the fibre structure, the fibre length and the tensile strength of the fibres differ very considerably. For this reason asbestos of different origins is individually opened up according to different methods.

35 These experiences have been confirmed in carrying out the method proposed by the invention in actual practice and it has been found that for the bending and rubbing of the asbestos fibres, which is necessary for
40 satisfactorily opening up the fibre bundles, it is sufficient in the case of crude asbestos with strong fibres, to press the bunched cohering fibre material suspended in a liquid, between rigid rubbing surfaces with controllable feed
45 pressure of the fibre-liquid mixture and friction and flexure of the fibres, while on the other hand it is advisable in the case of crude asbestos with delicate fibres, to feed the fibre-liquid mixture between rigid rubbing elements
50 and resilient counterelements with adjustable friction and flexure of the fibres. This manner of treatment ensures that each individual fibre is separated from neighbouring fibres without being torn and without changing its structure and natural length.

For effecting the best possible opening up of the fibres it is advantageous to feed the fibre-liquid mixture either in one or more
60 passes through the same fibre opening apparatus or through different such apparatus connected up in series. In the latter case the material can be passed several times through one or other of the apparatus.

65 As a rule it is desired, for shortening the period of opening up the fibres to exert the

most intensive possible friction on the asbestos fibres. For this purpose it is advisable in many cases to add to the fibre-liquid mixture a friction-increasing substance, for example sand, finely ground quartz, finely ground asbestos
70 blende, cement or a mixture of several of these substances. The friction-increasing substance or mixture of substances is worked with the opened fibre material to form the
75 asbestos cement finished products.

In developing this inventive idea the entire quantity of cement required for making the asbestos cement finished products can be added to the fibre-liquid mixture before the treatment of the fibres. If, for example, finely
80 ground quartz or finely ground asbestos cement blende is added to the fibre-liquid mixture when dressing crude asbestos, a considerable saving of cement (about 10% of the quantity of cement required without these
85 filling substances) is achieved. This has the effect on the one hand of lowering the cost of the finished products and on the other hand of considerably improving the elasticity of the finished products.

The idea of adding one or several admixture substances to the fibre-liquid mixture from the outset can be utilized with advantage also for the purpose of adding pigments for coloring the fibre material. The fibre material
90 already thoroughly dyed in the dressing process results in a very uniform colouring in the finished products.

When carrying out the method of the invention, apparatus of different kinds can be
100 employed depending upon the kind of crude asbestos to be dressed. For opening up or breaking up crude asbestos with robust fibres between rigid rubbing surfaces, a device comes
105 into question, for example, which comprises a conical housing having a rigid inner rubbing surface, a motor driven shaft axially disposed in said housing, and a conical working body mounted on said shaft with projections extending around its peripheral surface in spiral
110 lines and forming with the inner rubbing surface of the conical housing an annular narrow passage gap in the shape of a hollow truncated cone.

By this arrangement a particularly favourable breaking effect of the fibre material is
115 attained in that the fibre-liquid mixture in the passage gap, which is preferably made adjustable in width, is first at a relatively slow peripheral speed which away from the apex of the conical body gradually increases between the closely adjacent rigid surfaces of the conical housing and the conical body, thereby being thoroughly whirled that twisting
120 of the fibres is achieved.

For the gentle treatment of crude asbestos with delicate fibres between rigid rubbing surfaces and resilient counter rubbing surfaces, an apparatus is suitable in which a conical
125 body composed or having at least a surface

layer of rubber or a resilient plastics substance is arranged on a shaft mechanically driven with variable speed of rotation and so mounted in a conical housing that its wall surface and the rigid inner surface of the housing enclose a narrow passage gap in the shape of a hollow truncated cone.

In the last-mentioned apparatus a continuous to and fro bending and vigorous friction of the bundles of fibres and of the fibres gradually becoming loosened from the bundles of fibres, are attained in that the fibre-liquid mixture is fed through the passage gap of truncated conical shape between the rigid inner rubbing surface of the conical housing and the resilient conical wall surface of the correspondingly conical body with gradually increasing peripheral speed the further the fibre-liquid mixture approaches the end of the conical working body having the large base surface. The fibre-liquid mixture is thoroughly whirled during this feeding movement and as a result the fibre bundles and the individual fibres are repeatedly bent to and fro in different directions and while carefully treating the fibre material twisting of the fibres is attained at the same time, which to a high degree favours the opening up of the fibres.

The resilient conical body can with advantage be composed of a packet of annular discs of rubber or other resilient material, which are clamped on the shaft immediately adjacent one another. For treating less delicate fibres, however, an apparatus is also suitable in which the working or rubbing body consists of a conical metal body or a metallic hollow body coated with rubber or compressible resilient synthetic material.

In order to increase the frictional effect, the inner rubbing surface of the conical working body may be provided with annular grooves.

Expediently the conical working body is mounted on a sleeve which is adjustable and fixable in the longitudinal direction of the shaft, thereby to permit the width of the passage gap to be varied. To enable the adjustment of the resilient working body when the fibre opening apparatus is in operation, a handwheel may be screwed onto a screw-threaded section of the shaft outside the housing which handwheel when being operated will move the sleeve carrying the conical working body backwards and forwards on the shaft.

To ensure reliable working of the apparatus it is advisable that with the conical working body fixed on the shiftable sleeve a pressure spring is associated which holds the conical body in its operative position so that it can yield resiliently. If foreign bodies, such as unground clinker, pieces of asbestos blende, stones or pieces of iron get into the passage gap with the fibre-liquid mixture, the conical working body will then yield and the passage

gap be temporarily widened so that the foreign body can pass through the gap.

The means for adjusting the width of the truncated conical passage and for the resilient yielding of the conical working body can with advantage be combined by the arrangement of two sleeves on the shaft, one of which sleeves carries the conical working body and the other sleeve is in operative connection with the hand adjusting wheel, whereby the last-mentioned sleeve has a flange serving as supporting surface for a pressure spring, which pushes forward the conical working body into operative position, and for guiding bolts fixed on a plate holding the conical working body and welded on the shiftable sleeve, said bolts being provided with abutment nuts on screw threads at their free ends.

The end of the shaft carrying the shiftable sleeve with the conical working body is exposed and provided with a conical headpiece of hardened steel in the region of the point of the conical housing where the fibre-liquid mixture enters the passage gap. The exposed arrangement of the end of the shaft carrying the resilient working body contributes, on the one hand, to trouble-free working of the apparatus when foreign bodies accidentally get into the truncated conical passage gap and, on the other hand, facilitates the assembly and cleaning thereof. The conical steel headpiece keeps excessively large foreign bodies away from the passage gap and thus protects the apparatus against damage without itself being liable to damage by large foreign bodies.

In order to feed the fibre-liquid mixture to the truncated conical passage gap in a constant uniform stream, the housing may be constructed in the shape of a double cone having its apices or small base surfaces attached to each other, one of the two cones forming the double-cone surrounding the conical working body, while the other cone forms a chamber for the fibre-liquid mixture introduced under pressure.

If the crude asbestos material has to be treated particularly carefully in view of the delicacy of the individual fibres, it is advisable to employ an apparatus which comprises a cylindrical housing, a shaft with variable speed drive rotatably and axially mounted within said housing, a flexible resilient lining to the housing inflatable with compressed air, and/or a set of annular discs surrounding said shaft, said set being composed of alternately arranged rigid annular discs with a bore diameter greater than the diameter of the shaft and resilient annular discs of a material such as rubber with a bore diameter approximately equal to the diameter of the shaft and forming with the rigid discs annular chambers, and regulating elements for adapting the pressure of the fibre-liquid mixture fed to one end of the housing to the pressure exerted by the resilient



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lining so that when the shaft is rotating the fibre-liquid mixture will be forced between the lining and the shaft with the necessary frictional effect and the necessary intensity of bending.

The shaft of the apparatus may be driven through the intermediary of a variable speed gear.

When passing between the rotating shaft and the lining, the bundles of fibres are subjected to vigorous friction, which is adjustable in intensity, and at the same time the fibres are bent continuously to and fro, due, on the one hand, to the liquid pressure producing the feed movement and, on the other hand, to a transverse force component acting on the rotating shaft.

The apparatus for breaking or opening up fibrous asbestos bundles may also consist of two different series-connected devices of the aforesaid type, to achieve by such arrangement that the fibre bundles already partly loosened in the first part of the apparatus are subjected to repeated friction or rubbing in the second part of the apparatus owing to being forced between the inner edge of the hole of each rubber disc and the shaft, bending of the fibres being brought about when the fibres bend outwards upon entering the annular chambers defined by the bores of the rigid annular discs.

To render particularly intensive the repeated bending of the fibres, which is necessary for opening up the fibres in a perfect manner, the shaft can be provided with one or more flat ribs extending on a helical line in the section surrounded by the resilient counter pressure elements. However, these ribs are not provided for feeding the fibre-liquid mixture through the apparatus since feeding is effected in any case, as has already been mentioned, by the inflow pressure. The helically extending ribs actually serve for bending the fibres into a second plane as they pass between the shaft and the resilient counter pressure elements.

Several embodiments of apparatus suitable for carrying out the method of breaking or opening up crude asbestos according to the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal section through a first embodiment of a fibre opening apparatus with two different groups of rigid rubbing surfaces and resilient counter rubbing surfaces;

Figs. 2 and 3 are elevational views, on a smaller scale, of details of the apparatus illustrated in Fig. 1;

Fig. 4 is a diagrammatic view of the arrangement of a plant in which the fibre material is circulated several times through the fibre opening apparatus;

Fig. 5 is a vertical longitudinal section

through a second embodiment of the apparatus incorporating a resilient conical working body and a rigid counter pressure surface;

Fig. 6 is a vertical longitudinal section through a third embodiment of the apparatus having a conical working body and a rigid counter pressure surface, the former being resilient on its surface only, and

Fig. 7 is a longitudinal section through an embodiment having a rigid conical working body and a rigid counter pressure surface, and a diagram of aggregates for opening apparatus, the aggregates being drawn without taking into consideration the proper dimensional relationship to the opening apparatus.

In all the figures, similar or similarly acting parts are designated by similar reference numerals.

In Fig. 1, reference numeral 1 designates a horizontally arranged elongated housing of an apparatus for opening up crude asbestos which has on the left-hand side of this Figure a rigid end wall 2 and is closed on the right-hand side by a screwed-on cover 3. In a central bore 4 in the end wall 2, a shaft 5 is rotatably mounted and extends through the entire length of the housing 1. As shown in Fig. 4, the end of the shaft 5 projecting beyond the end wall 2 is connected to an electric motor 7 through the intermediary of a variable intermediate gear 6 and can be driven at an adjustable speed. The other end of the shaft passes through a central bearing bore 8 in the cover 3. Longitudinal channels 9 are formed in the bearing bore 8 for the discharge of the fibre-liquid mixture from the apparatus.

Behind the end wall 2 (Fig. 1) there is an annular chamber 10 which is open towards the shaft 5. This annular chamber 10 communicates with a container 13 (Fig. 4) by means of a connecting piece 11 and a pipe conduit 12 connected thereto, which container 13 accommodates asbestos material to be opened up, which is mixed with water or any other suitable liquid. In the pipe conduit 12 a feed pump 14 is arranged which feeds in the arrowed direction, the asbestos material suspended in liquid into the annular chamber 10 under high pressure.

Between two partition walls 15 and 16, of which the partition wall 15 shown on the left of Fig. 1 and extending at an incline to the shaft 5 forms part of the wall surrounding the annular chamber 10, there is a space 17 for receiving an inflatable hollow body 18 of annular cross-section and made from rubber or other flexible and resilient material. The annular hollow body 18 is inflated by means of a connecting piece 19 passing through the wall of the housing 1 and fitted with a check valve (not shown in the drawing), to such an extent that the cylindrical inner wall of the annular hollow body 18 bears tightly against the shaft 5. The inflation pressure must be

so adapted to the pressure produced by the feed pump 14 that the latter is capable of forcing the fibre-liquid mixture slowly between the cylindrical inner wall of the annular hollow body 18 and the shaft 5 in the direction towards the other end of the shaft thereby pushing back the resiliently flexible cylindrical inner wall of the inflated annular hollow body 18.

As the shaft 5 rotates during this operation, the fibre bundles passing between the shaft 5 and the resilient body 18 are divided up into separate fibres in a gentle manner by friction and the individual separated fibres are continually bent to and fro on the surface of the shaft 5 as they continue to pass through the narrow gap between the cylindrical inner wall of the annular hollow body 18 and the shaft 5.

The bending movement is caused by the fact that the cylindrical inner wall of the annular hollow body 18, under the influence of the feed pressure, is not lifted continually the same distance from the shaft 5 at all points of its cylindrical surface but is pressed in more strongly at some places than at others, whereby the strongly pressed-in places change continually. As a result, the fibres are alternately subjected to the feed pressure moving them along the shaft 5 and to the peripheral force of the revolving shaft 5 acting transversely to the longitudinal direction of the shaft, so that the fibres continually change their direction of travel.

In the embodiment illustrated in Fig. 1, the apparatus comprises two functionally different sections, that is, in addition to the above-described first section a second section which is separated from the first section by the partition wall 16 removably fitted in the housing 1 and surrounding the shaft 5 with clearance. Between the partition wall 16 and the cover 3 screwed on to the housing 1 a set of annular discs is clamped. This set consists of alternately arranged rubber discs 20, the bore diameter of which is so dimensioned that it fits the shaft 5 closely or with a small annular clearance only, and of a rigid annular discs 21 made, for example, of metal and having a bore diameter which is considerably larger than the diameter of the shaft 5 so that annular spaces or chambers 22 are formed between these annular discs 21 and the shaft 5. The annular discs 20 and 21 are not axially shiftable in the housing 1 by means of the screwed-on cover 3 and are secured against rotation in that they are provided, as shown in Figs. 2 and 3 with noses 20^a and 21^a, respectively, which project from their periphery and engage in a longitudinal groove 23 in the inner wall surface of the housing 1 (Fig. 1).

The fibre-liquid mixture passing through the central bore in the partition wall 16 into the second section of the apparatus is forced through the small annular clearance between

the first rubber disc 20 and the shaft 5 whereby the fibres are subject to strong friction. When entering the annular chamber 22 adjoining the first rubber disc 20, the fibres will buck and thus be bent and relieved in the annular chamber 22. The fibre-liquid mixture pressing forward conveys the fibres with the liquid surrounding them past the next rubber disc 20 into the annular chamber 22 following it, whereby the fibres are again subjected to strong friction and to bending when entering the next annular chamber 22. This procedure is repeated at each successive rubber disc 20 and annular chamber 22.

The fibre-liquid mixture is forced out of the last annular chamber 22 through the already mentioned channels 9 in the bearing bore 8 in the cover 3 into a pipe conduit 24 (Fig. 4) in which it is conveyed to a further treatment stage, for example a drying place, or is returned through a two-way cock 25 arranged in the pipe conduit 24 and a branch conduit 26 into the container 13 from which the fibre-liquid mixture is again forced into the apparatus by the feed pump 14. Thus the fibre-liquid mixture can be fed once or in repeated circulation through the apparatus until the fibre bundles are completely loosened or opened up in the desired manner.

As indicated in dot and dash lines in Fig. 1, the shaft 5 can have one or several ribs 27 extending in a helical line and bending the fibres when they slide over the ribs in their forward movement under the feed pressure.

Depending upon the kind and quality of the asbestos material to be opened up, it may possibly be sufficient to equip the apparatus only with one or other of the two different sections of the combined apparatus described above.

For the proper function of the apparatus it is immaterial whether it is provided with a horizontal shaft as shown in Fig. 1, or with an upright shaft.

In Fig. 5 an upright inverted funnel-shaped housing 31 with lateral brackets 33 is fixed on vertical rails 32 of a carrier frame and provided with annular grooves 31c. The upper end of the housing 31 is provided with a flange 34 and connected to a pipe conduit 12 through which the fibre-liquid mixture sucked by a feed pump out of a container is pressed from above in the direction of the arrow with adjustable pressure into the conical housing 31. At the other end having the greater diameter the conical housing 31 is connected by flanges 35 and 36 to a cylindrical housing 37 which forms a collecting chamber 38 for the fibre-liquid mixture fed through the apparatus. The fibre-liquid mixture is led off from the collecting chamber 38 through a lateral connecting piece 39 of the housing 37 to a pipe conduit extending from the connecting piece 39, either after it has passed only once through



they

the apparatus or, if the kind of fibre material to be opened up makes it necessary, after it has passed twice or several times through the apparatus. For this purpose a two-way cock is fitted in the discharge conduit in the manner described in connection with the diagramm shown in Fig. 4, and it is possible to adjust the plug of the cock so that the fibre-liquid mixture is either conducted to a place for further treatment or drying, or is returned into the circulation through the said container and the feed pump to again pass through the apparatus.

The free or exposed upper end of a shaft 41 passes through a shiftable bearing sleeve 40 in a central aperture in the end wall of the housing part 37 into the two-part housing 37,31. The shaft 41, driven by an electric motor through a variable speed gear, is rotatable in two thrust bearings 42 which are fixed by means of brackets 43 on the vertical rails 32 of a carrier frame. On the free end of the shaft 41 a sleeve 45 is slipped which is connected for rotation to the shaft 41 by means of a key 44 and longitudinally shiftable on this shaft. On the upper end of the sleeve 45 projecting upwards beyond the shaft 41 a conical working body 27¹ is fixed between two plates 46 and 47. This conical working body consists of a plurality or set of annular discs 27a of rubber or resilient synthetic substance, progressively larger in diameter, threaded on the upper end of the sleeve 45 and tightly clamped with their end faces bearing one against the other.

The plate 46 arranged in front of the small base of the conical body 27¹ is held and covered by a conical headpiece 50 of hardened steel. The headpiece 50 is provided with a screw pin 51 which is screwed into the screw threaded bore of a metal piece 52 which is welded on the front end of the metal sleeve 45 and closes the sleeve at its front end. The larger plate 47 is welded on the sleeve 45. By screwing the headpiece 50 more or less tightly, it is possible to impart to the set of discs 27a the correct initial stress.

A plurality of bolts 53 extending parallel to the shaft 41 are fixed on the plate 47 and provided at their free ends with screw threads which extend through bores 55 in a flange 54 firmly welded on the shiftable bearing sleeve 40. A strong helical pressure spring 56, placed under initial stress between the plate 47 and the flange 54, tends to shift the sleeve 45 carrying the conical body 27¹ as far forward as abutment nuts 57 screwed on the screw-threaded ends of the bolts 53 and locked in a suitable manner, will allow.

The resilient conical working body 27¹ is, as a rule, yieldably held within the housing 31 coaxially thereto by means of the pressure spring 56 in such a position that between the rigid inner wall surface of the housing 31 and the elastic outer surface of the conical working

body 27¹ there is a narrow cone-shaped passage gap 58. If foreign bodies for example larger pieces of asbestos blende or shale, stones or pieces of iron should enter the cone-shaped passage gap 58 with the fibre-liquid mixture, the conical working body 27¹ yields in that it is pushed back on the shaft with the sleeve 45, thereby compressing the helical spring 56, with the result that the passage gap 58 is widened temporarily to such an extent that the foreign bodies can pass therethrough.

To enable the width of the passage gap 58 to be adjusted to suit the kind of fibre material to be treated, a handwheel 59 is provided which has a screw-threaded boss 60 which is screwed on to a screw-threaded section 41a in the middle of the shaft 41. A flat ring 61 is screwed on to the end face of a part of the handwheel boss 60 extending over the rear end portion of the sleeve 40 and the inner edge of this ring engages in an annular groove 62 formed in the periphery of the sleeve 40. By turning the handwheel 59 in one direction the sleeve 40 and the conical working body 27¹ connected thereto by the pressure spring 56 will be shifted nearer to the small base of the conical housing 31 so that the passage gap 58 becomes narrower, whereas by turning the handwheel 59 in the opposite direction the distance of the surface of the conical working body 27¹ from the inner wall of the conical housing 31 will be increased and the passage gap 58 widened accordingly. The handwheel 59 is locked against unintentional turning when in its adjusted position by means of a counter nut 63.

A concertina wall 64 is fixed at one end to the plate 47 and at the other end to the flange 54 and prevents the fibre-liquid mixture entering the chamber 38 through the passage gap 58 from reaching the helical spring 56 and thus eliminates failures of the spring which might otherwise occur through fibre material or hard foreign bodies getting between the winding of the helical spring 56.

The apparatus illustrated in Fig. 6 consists of a double conical housing 31a, 31b, which is hung by means of brackets 33 on vertical rails 32 of a carrier frame. The upper conical housing part 31a is closed by a plate 75 and has on this plate a feed connecting piece 76 constructed as a bend through which the fibre-liquid mixture is forced, as described in connection with the embodiment shown in Fig. 1, by a feed pump into the conical chamber 77 in the upper housing part 31a. The lower conical housing part 31b surrounds a working body 28¹ constructed as a metal cone or a metallic hollow cone which is provided on the outer conical surface with a coating 29 of rubber or resilient plastics substance. The conical working body 28¹ is secured on a vertical shaft 41 by means of fittings keys 78 so that it is slidable along the vertical shaft 41 but permanently connected and rotatable

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therewith. The shaft 41 is rotatably mounted at its lower end in an axial pressure bearing 79 and at its upper end in a self-aligning ball bearing 80. The axial pressure bearing 79 is bolted on horizontal rails 32a of the carrier frame and the self-aligning ball bearing 80 is fitted in a boss 81 which is secured by several ribs 82 on the upper side of the plate 75.

The shaft 41 extends through a central aperture in the plate 75. A stuffing box 83 of known construction is fitted in this aperture and its packing rings 84 are held together by an adjustable part 83a of the stuffing box. By tightening nuts 85 on screw bolts 86, which pass through bores in the flanges 87 and 88 of the stuffing box 83 and the adjustable stuffing box part 83a respectively, the packing rings 84 can be pressed together with the necessary pressure.

The point or apex of the pointed conical hollow working body 28¹ made from thick sheet iron is reinforced by an inner conical metal piece 89 having a central bore. A longitudinal groove 90 extends through the metal piece 89 for receiving a fitting key 78 for securing the shaft 41 passing through the bore. The lower end of the conical hollow body 28¹ is closed by a plate 91 welded thereon. In a central bore of this plate 91 a ring-shaped body 92 is welded which is also provided with a continuous longitudinal groove 93 for receiving a second fitting key 78. Several downwardly directed screw-threaded bolts 94 are fixed in bores of the ring-shaped body 92 on a common arc at uniform distance apart and parallel with the shaft 41. The screw-threaded bolts 94 pass through bores in a ring 95 welded on a collar 96 of the shaft 41 and are held against the ring 95 by nuts 97. By adjusting these nuts 97 the hollow working body 28¹ can be shifted upwards or downwards in relation to the lower part 31b of the housing so that the truncated conical passage gap 58 existing between the outer wall surface of the conical hollow working body 28¹ or its elastic coating 29 and the rigid conical inner wall surface of the lower part 31b of the housing becomes correspondingly smaller or larger.

The fibre-liquid mixture pumped into the chamber 77 by the feed pump enters the gap 58 between the conical working body 28¹ or its resilient coating 29 and the inner wall surface of the lower housing part 31b. Its entry into this truncated conical passage gap 58 is facilitated by the fact that the upper end section of the conical hollow working body 28¹ is constricted in the region where the coating 29 ends, with a somewhat larger conical angle than the remaining part of the conical hollow working body.

The fibre-liquid mixture passing out from the passage gap 58 is caught in an annular groove 98 and forced by a feed pump through a pipe conduit 99 in which a two-way cock is fitted, to another place for further treatment

or is returned into the apparatus, to be circulated a second time or several times via the container from which it is sucked by the feed pump.

In Fig. 7 the container in which the fibre material to be opened up is held suspended in liquid is designated by reference numeral 13. A substance which increases friction, such as sand, finely ground quartz, finely ground asbestos blende, cement or several of these substances and if desired also colouring matter, can be added to the fibre-liquid mixture in the container 13. The feed pump 14 sucks out the fibre-liquid mixture through a suction conduit 12a and forces it through the dressing apparatus via a pipe conduit 12b under pressure which can be adjusted by varying the number of revolutions of the pump. At the outlet connecting piece of the apparatus a two-way cock 25 is fitted the plug of which can be set so that the fibre-liquid mixture when the fibre bundles have been completely opened up during their first passage through the apparatus, is immediately conducted through the pipe conduit 24 in the direction of the arrow x for a station for further treatment, or, when the fibre bundles are not completely opened up, is fed through a branch conduit 26 in the direction of the arrow y to be circulated a second or several times through the apparatus via the container 13 and the feed pump until the fibres are opened up to the desired degree.

In Fig. 7, the apparatus consists of a conical housing 31d which is arranged either in vertical position with its small base surface directed downwards, or horizontally, as shown, resting on carrier rails 32¹ with the aid of supports 33¹. The pipe conduit 12b is connected up to the admission end of the conical housing 31d which is provided with a flange 34 for this purpose. A cylindrical housing 37 is connected to the other end of the conical housing 31d which is of larger diameter by means of flanges 35 and 36, this housing 37 forming a collecting space 38 for the fibre-liquid mixture forced between the rigid rubbing surfaces, and carrying the discharge connecting piece 39 on its cylindrical wall.

The apparatus shown in Fig. 7 is equipped with a device for axially shifting a conical working body 48 with the object of changing the width of the passage gap 58 and the conical working body 48 is acted upon by a pressure spring 56 shifting it into the working position and allowing it to yield resiliently in the event of hard foreign bodies entering the passage gap 58. These details and the conical steel headpiece 50 forming the point or apex of the conical working body 48 are the same as in the embodiment described with reference to Fig. 5 so that it is not necessary to describe them again here.

For increasing the hourly throughput capacity several of the apparatus above

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described can be connected up in series. Another possibility recommendable in many cases for obtaining the best possible opening up of the fibre material, consists in that, following an apparatus or a set of apparatus according to one of the aforescribed embodiments, one or more different apparatus may be connected up.

WHAT I CLAIM IS:—

- 10 1. A method of opening up fibrous bundles of crude asbestos separated from the source rock, in which the bundles of fibres are mixed with a liquid and fed through between rubbing surfaces, characterized in that over a long
- 15 path formed by the rubbing surfaces and extending helically or according to a spiral space curve and having a length amounting to a multiple of the greatest fibre length, the fibre-liquid mixture is forced through between the rubbing surfaces with controllable high hydraulic pressure so that the fibres are
- 20 *fibre* 25 2. A method as claimed in claim 1, wherein the fibre-liquid mixture is fed between rigid rubbing surfaces and resilient counter rubbing surfaces for subjecting the fibres to adjustable friction and bending.

30 3. A method as claimed in claim 1, wherein the fibre-liquid mixture is conducted several times through one and the same apparatus.

35 4. A method as claimed in claim 1, wherein the fibre-liquid mixture is fed through a plurality of different apparatus connected up in series.

40 5. A method as claimed in claim 1, wherein a friction-increasing substance selected from the group consisting of sand, finely ground quartz, finely ground asbestos blende and cement is added to the fibre-liquid mixture before being fed between the rubbing surfaces.

45 6. A method as claimed in claim 1, wherein the fibre-liquid mixture, before being forced between the rubbing surfaces, is mixed with the cement required for producing asbestos cement products.

50 7. A method as claimed in claim 1, wherein colouring matter is added to the fibre-liquid mixture.

8. A method of opening up fibrous bundles of crude asbestos separated from the source rock substantially as described.

For the Applicant,
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described can be connected up in series. Another possibility recommendable in many cases for obtaining the best possible opening up of the fibre material, consists in that, following an apparatus or a set of apparatus according to one of the aforescribed embodiments, one or more different apparatus may be connected up.

WHAT I CLAIM IS:—

1. A method of opening up fibrous bundles of crude asbestos separated from the source rock, in which the bundles of fibres are mixed with a liquid and fed through between rubbing surfaces, characterized in that over a long path formed by the rubbing surfaces and extending helically or according to a spiral space curve and having a length amounting to a multiple of the greatest fibre length, the fibre-liquid mixture is forced through between the rubbing surfaces with controllable high hydraulic pressure so that the fibres are full or squeezed in constantly varying directions by being continually bent transversely of their longitudinal extension.

2. A method as claimed in claim 1, wherein the fibre-liquid mixture is fed between rigid rubbing surfaces and resilient counter rubbing surfaces for subjecting the fibres to adjustable friction and bending.

3. A method as claimed in claim 1, wherein the fibre-liquid mixture is conducted several times through one and the same apparatus.

4. A method as claimed in claim 1, wherein the fibre-liquid mixture is fed through a plurality of different apparatus connected up in series.

5. A method as claimed in claim 1, wherein a friction-increasing substance selected from the group consisting of sand, finely ground quartz, finely ground asbestos blende and cement is added to the fibre-liquid mixture before being fed between the rubbing surfaces.

6. A method as claimed in claim 1, wherein the fibre-liquid mixture, before being forced between the rubbing surfaces, is mixed with the cement required for producing asbestos cement products.

7. A method as claimed in claim 1, wherein colouring matter is added to the fibre-liquid mixture.

8. A method of opening up fibrous bundles of crude asbestos separated from the source rock substantially as described.

For the Applicant,
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