Feb. 18, 1969 K. A. OESTERHELD 3,428,265

APPARATUS FOR DRESSING CRUDE ASBESTOS SEPARATED FROM THE SOURCE ROCK

Filed Aug. 23, 1966 Sheet 1 of 2

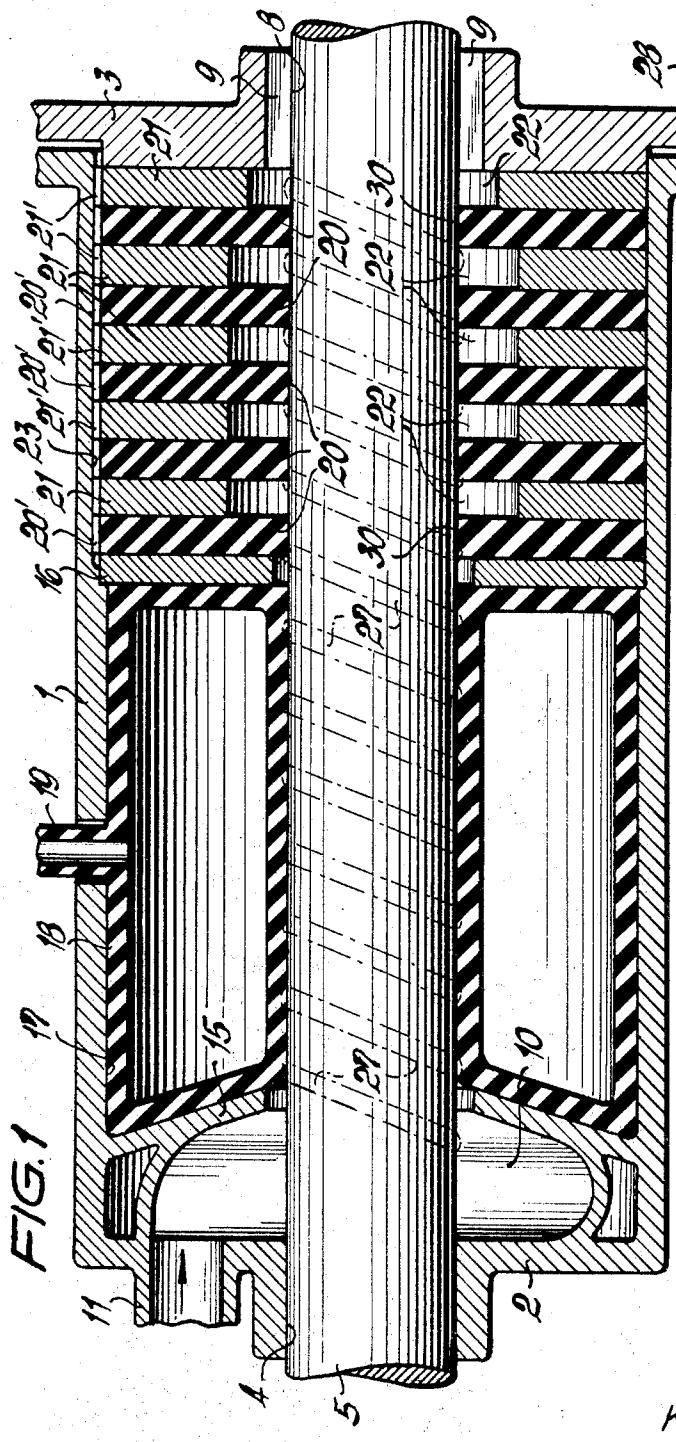


FIG. 1

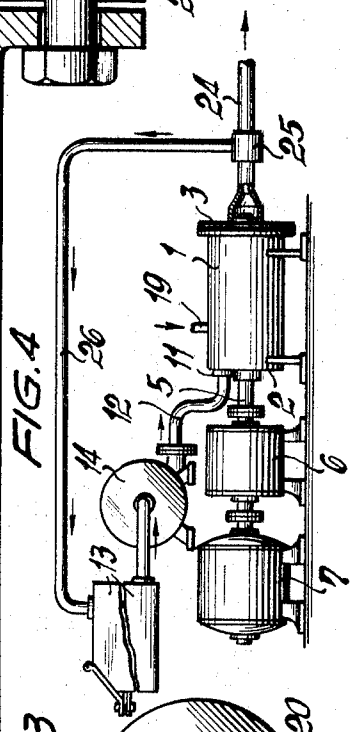


FIG. 4

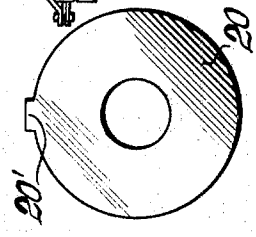


FIG. 3

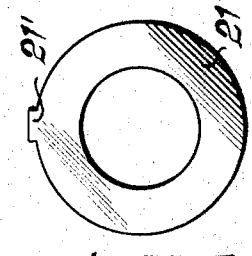


FIG. 2

INVENTOR

KARL A. OESTERHELD

By Lowry & Rinehart

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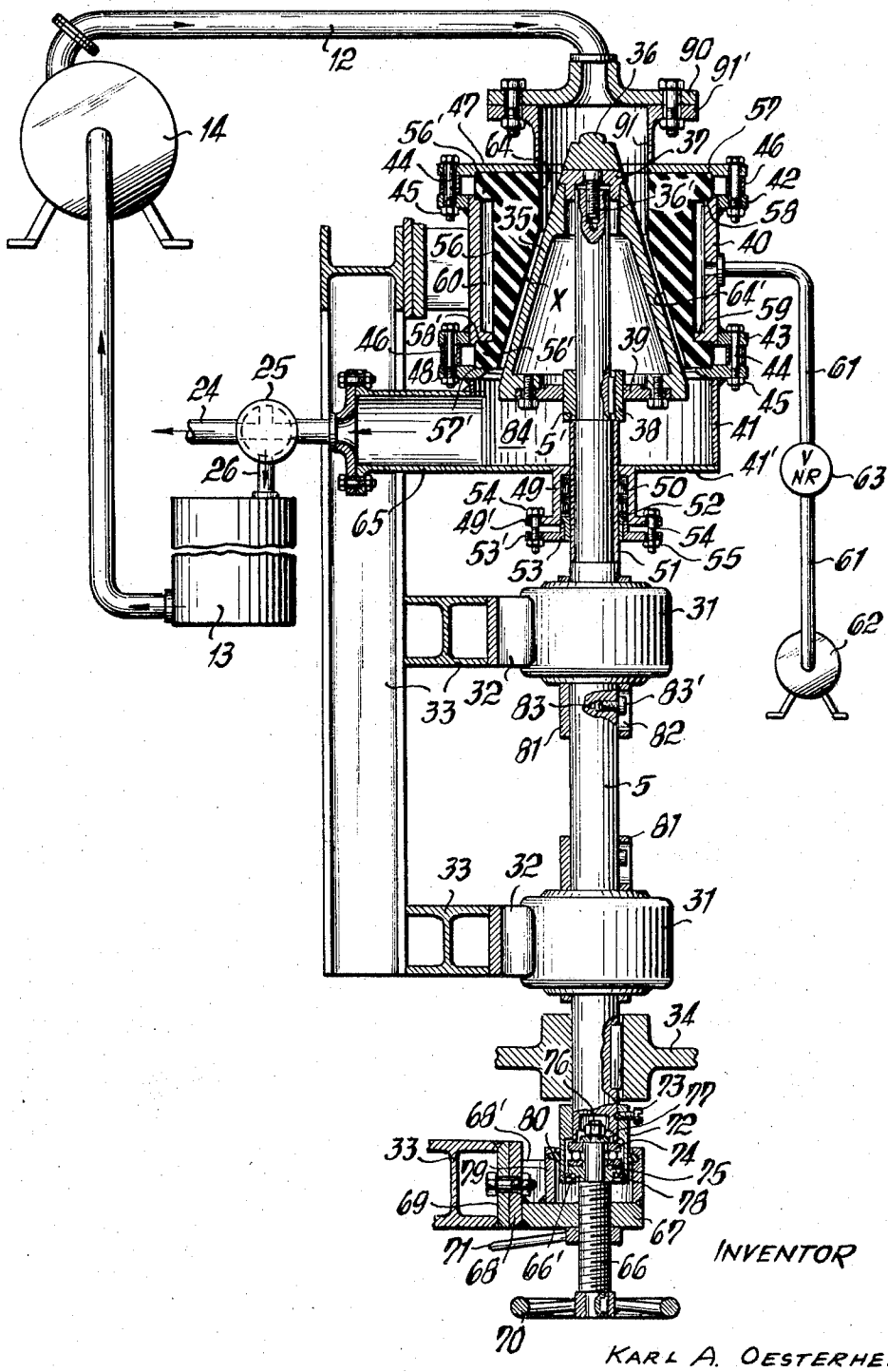
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FIG. 5



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APPARATUS FOR DRESSING CRUDE ASBESTOS SEPARATED FROM THE SOURCE ROCK

Karl Adolf Oesterheld, Luthe, near Wunstorf, Hannover, Germany

Continuation-in-part of application Ser. No. 413,665, Sept. 9, 1964. This application Aug. 23, 1966, Ser. No. 574,425

Claims priority, application Germany, July 20, 1960, O 7,532

U.S. Cl. 241—259 9 Claims

Int. Cl. B02c *13/26, 25/00*

This invention relates to an apparatus for dressing crude asbestos separated from the source rock and is a continuation-in-part of the divisional application, Ser. No. 413,665, filed Sept. 9, 1964, now Patent No. 3,286,940, and embodies improvements in the art thereover.

In my U.S. Patent 3,170,834 a method of opening up fibrous bundles of crude asbestos separated from the source rock is described which enables the fibers hanging firmly together in bundles to be opened up to such a degree of perfection while maintaining the natural length of the fibers and without damaging the structure of the fibers that was not attainable with the previously known dressing methods and apparatuses used in practice. This success is based on the fact that the crude asbestos material suspended in a liquid is forced by means of a pump with controllable hydraulic pressure between the inner wall of a housing and the surface of a motor-driven shaft or a rotor mounted on the shaft along rigid friction surfaces and elastically yielding counterfriction surfaces over a long helical path having a length amounting to a multiple of the length of the fibers and during this operation the fibres are subjected to friction and continuously bent to and fro in constantly varying directions. The frictional effect and bending effect causing the fibers to be completely opened up can be realized by various apparatuses of appropriate construction, e.g. by the apparatus shown and described in my pending U.S. patent application Ser. No. 413,665, which apparatus consists of a conical housing and a conical rotor rotatably mounted in the housing and formed of a plurality of annular rubber disks fixed on a motor-driven shaft.

Practice has shown that the kinds of asbestos varying considerably according to the place of their origin must be subjected in each case to a particular individual treatment when it is intended to achieve the best possible degree of dressing the fibers while meeting at the same time the requirements that the natural length of the fibers should be maintained and the fibers should not be damaged. By controlling the hydraulic pressure with which the fiber-liquid mixture is forced by the feed pump through the dressing apparatus between the rigid friction surfaces and the elastically yielding counterfriction surfaces and/or by varying the speed of the shaft rotatably mounted in the housing, it is not possible to regulate the operation of the dressing apparatus in a fully satisfactory manner. A third possibility of influencing the operation of the dressing apparatus consists in varying the elastic compressibility of the elastically yielding counterfriction surface cooperating with the rigid friction surface in accordance with the respective requirements.

It is the object of the present invention to construct the elastic counterfriction surface in such a way that a change of its elastic compressibility can be effected with

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simple means and in a convenient manner and performed any time during the operation of the dressing apparatus.

This object is achieved according to the invention in that a housing of the dressing apparatus accommodates a lining of elastically yielding material which is inflatable with compressed air and in its fully inflated condition engages closely the surface of a shaft or of a rotor mounted on the shaft and a regulating member is fitted in a compressed-air pipe subjecting the lining to the action of compressed air, the operation of which regulating member permits the bearing pressure of the lining against the shaft or the rotor to be adjusted in such a manner that it ensures, in conjunction with the hydraulic feed pressure and with the speed of the shaft, the frictional effect and the intensity of bending necessary for completely opening up the fibrous bundles.

The apparatus for dressing fibers as proposed by the present invention may be used equally well for all kinds of asbestos because the elastic compressibility of the inflatable lining can be very accurately regulated. It saves the purchase and provision of a plurality of apparatuses which can be used only for opening up crude asbestos having particular properties, such as, e.g. short-fibered, medium-fibered or long-fibered crude asbestos, or for asbestos material with a definite thickness of the individual fibers. The arrangement of the inflatable lining provides the advantageous possibility of bringing the elastic counterfriction surface into engagement with the motor-driven shaft expediently equipped with one or several helical flat ribs or with the rotor mounted on the shaft by increasing the internal pressure and without leaving a gap between the engaging parts, after previously the regular passage of the fiber-liquid mixture in a helical flow has been initiated with the lining first inflated to a slight degree only and consequently lifted slightly off the shaft or the rotor.

The inflatable elastic lining, in case it is heavily worn after a long period of use, can be replaced in a simple manner by a new lining without excessively high costs and without the dressing apparatus becoming unserviceable for a longer period of time.

The rotor co-operating as a rigid rotating friction surface with the inflatable lining acting as elastically yielding counterfriction surface may be of solid construction or constructed as a hollow body in cylindrical form or in the form of a truncated cone. The inner wall surface of the inflatable lining must in any case be such that the lining in its inflated condition tightly encloses the rotor at least with a section of its inner wall surface.

In some kinds of asbestos the best degree of opening up the fibers is achieved when the fibrous bundles are first subjected to a less heavy rubbing and bending action and subsequently submitted to an intensified after-treatment. To be able to carry out also such manner of treatment with the dressing apparatus as proposed by the invention, the invention further suggests to arrange a packet of annular disks in the housing on the downstream side of the inflatable lining surrounding the shaft equipped with one or several helical flat ribs, which packet of annular disks is composed of rigid annular disks with a bore diameter greater than the diameter of the shaft and yieldable annular disks of elastic material, such as, e.g. rubber, with a bore diameter equal or approximately equal to the diameter of the shaft, the rigid annular disks being ar-

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ranged so as to alternate with the yieldable annular disks thereby to form annular chambers.

The bearing pressure of the annular rubber disks against the shaft can be varied in a range which is, however, not very wide by tightening to a more or less great extent screws which connect a cover of the housing to the body of the housing, thus increasing or reducing the pressure exerted by the cover on the annular disks of the packet of annular disks, whereby an appropriate bearing pressure of the annular rubber disks against the shaft is obtained. In this case it is, of course, not possible to regulate the bearing pressure as accurately as in the case of the elastically yielding inflatable lining, but this is not necessary for the intensified after-treatment of the asbestos fibers which are in part already opened up by the inflatable lining.

Two embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic longitudinal section through a first embodiment of the dressing apparatus according to the invention having an inflatable lining directly enclosing the motor-driven shaft and further having a second functional part for the intensified after-treatment of the fibers arranged on the downstream side of the lining;

FIGS. 2 and 3 are diagrammatic side elevational views, on a reduced scale, of component parts of the apparatus of FIG. 1;

FIG. 4 is a diagrammatic view of a plant in which the fiber-liquid mixture is circulated several times through the dressing apparatus of FIG. 1, and

FIG. 5 is a diagrammatic longitudinal section through a second embodiment of the dressing apparatus having an elastically yielding inflatable lining which encloses a conical rotor.

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

In FIG. 1, reference numeral **1** designates a horizontally arranged elongated housing of a dressing apparatus 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 rigid shaft **5** is rotatably mounted which 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 fiber-liquid mixture from the dressing 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 dressed 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 rubber-like 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 manually regulable check valve (not shown in FIGS. 1 and 4 of the drawings), 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 fiber-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 elastically yieldable cylindrical inner wall of the inflated annular hollow body **18**.

As the shaft **5** rotates during this operation, the fiber bundles passing between the shaft **5** and the elastically yieldable hollow body **18** are divided up into separate fibers in a gentle manner by friction and the individual separated fibers 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 fibers 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 fibers are continually turned and twisted during the rotary movement of the shaft and thereby continually bent to and fro over their entire length in constantly varying directions.

In the example illustrated in FIG. 1, the apparatus is equipped not only with dressing or working elements as described above in a first functional part but also with working elements by which the rigid shaft **5** also cooperates with elastically yieldable counter pressure elements arranged in a second functional part. This second functional part is separated from the first functional part 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 packet of annular disks **20**, **21** is clamped. This packet consists of alternately arranged rubber disks **20**, the bore diameter of which is so dimensioned that these disks fit closely around the shaft **5** or extend up to the shaft leaving only a small annular slit up against the shaft, and of rigid annular disks **21** made, for example, of metal and having a bore diameter which is considerably larger than the diameter of the shaft, so that annular spaces or chambers **22** are formed between these annular disks **21** and the shaft **5**. The annular disks **20** and **21** are not axially shiftable in the housing **1** by means of the screwed-on cover **3** and secured against rotation in that they are provided, as shown in FIGS. 2 and 3, with noses **20'** and **21'**, respectively, which project from their periphery and are slipped into a longitudinal groove **23** in the inner wall surface of the housing **1** (FIG. 1).

The fiber-liquid mixture passing through the central bore in the partition wall **16** into the second functional part of the dressing apparatus is forced through the small annular slit of the first rubber disk **20**, whereby the fibers are subject to strong friction. On entering the annular chamber **22** adjoining the first rubber disk **20**, the fibers turning upwards are bent and relieved in the annular chamber **22**. The fiber-liquid mixture pressing forward conveys the fibers with the liquid surrounding them past the next rubber disk **20** into the annular chamber **22** following it, whereby the fibers are again subjected to strong friction and on entering the next annular chamber **22** are bent. This procedure is repeated at each successive rubber disk **20** and annular chamber **22**.

The fiber-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

fiber-liquid mixture is again forced into the dressing apparatus by the feed pump **14**. Thus the fiber-liquid mixture can be fed once or in repeated circulation through the dressing apparatus until the fiber bundles are completely loosened 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 assisting in bending the fibers to and fro when the latter slide over the ribs in their forward movement under the feed pressure.

When a kind of asbestos material is concerned in which the individual fibers do not stick together too tightly or are very sensitive, it is recommendable to use only that functional part of the dressing apparatus which has the inflatable hollow body inserted therein. For this purpose either the annular disks **20** and **21** may be removed from the housing **1** or a dressing apparatus may be used which has only the inflatable hollow body **18** inserted therein. In each case the hollow body **18** will be inflated only to a slight extent at the commencement of the opening-up operation in order to first initiate the helical circulating movement of the fiber-liquid mixture in the apparatus and subsequently, by operating the regulating member in the compressed-air pipe leading to the hollow body **18**, the internal pressure in the hollow body and consequently the bearing pressure of the cylindrical inner wall of the hollow body **18** against the shaft **5** can be so adjusted to the hydraulic pressure with which the fiber-liquid mixture is conveyed by the feed pump **14** through the dressing apparatus and to the speed of the shaft **5** that the fibers of the crude asbestos material will be completely separated from one another but not shortened and not damaged in their structure.

The operation of the second functional part of the dressing apparatus containing the rigid annular disks **21** and the annular rubber disks **20** can be adjusted only to a limited extent by tightening more or less strongly nuts **28** on bolts **29** connecting the cover **3** with the housing **1**. This causes the walls **30** of the holes in the annular rubber disks **20** to be pressed more or less strongly against the shaft **5**.

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

FIG. 5 shows an apparatus for dressing crude asbestos which has a vertically disposed shaft **5** rotatably mounted in two bearings **31**. The bearings **31** are mounted by means of lateral trestles **32** to I-rails **33** of a supporting structure. The shaft **5** is driven through the intermediary of a belt pulley **34** only part of which is shown in the drawing and which is connected to a variable speed gear of known construction (not shown). Arranged on the free end of the shaft **5** is a rotor **35** consisting of a metallic hollow body and secured to the shaft **5** by a headpiece **36** of hardened steel. The headpiece **36** is screwed with a threaded shank **36'** into a central tapped hole in the shaft **5** and presses by means of an interposed sleeve **37** in axial direction against the body of the rotor **35**, so that a hub **38** of an annular disk **39** to which the rotor **35** is fastened by means of screws and which forms the end wall at the broader base of the conical hollow body, bears heavily against a shoulder **5'** on the shaft **5**.

The rotor **35** is surrounded by a housing. The housing consists of a two-part cylindrical wall, the one part **40** of which has a substantially greater wall thickness than the other part **41**. To the two ends of the part **40** of the wall of the housing flanges **42** and **43** are welded. An annular disk **47** is fastened to the upper flange **42** in FIG. 5 by screw bolts **44** and nuts **45** with the interposition of spacers **46** supporting the annular disk, which disk forms the upper end wall of the housing. Connected to the flange **43** of the part **40** of the wall also by screw bolts **44** surrounded by spacers **46** and nuts **45** is a counterflange **48** which is welded to the part **41** of the cylindrical wall of the housing which is of smaller wall thickness and has an end wall **41'** firmly connected thereto by welding. A hub **49** fixed in a central bore in the end wall **41'** of the housing by welding serves for the reception of a stuffing-box packing **50** composed of a plurality of rings consisting of tallow cords or the like. The section of the shaft **5** positioned in the region of the stuffing-box packing **50** is provided with a bushing **51** protecting this section of the shaft.

Arranged in front of the stuffing-box packing **50** are a sleeve **52** and a packing gland **53**, the latter being provided with an outer flange **53'** which is connected by screw bolts **54** and nuts **55** to a counterflange **49'** on the hub **49**. By tightening the bolt nuts **55** the packing gland **53** permits in a known manner to readjust the stuffing-box packing **50** when the passage for the shaft in the stuffing-box packing is no longer entirely leakproof.

The relatively large free annular space between the conical outer wall surface of the rotor **35** and the cylindrical inner surface of the part **40** of the cylindrical wall of the housing is filled by a thick-walled rubber lining **56**. The rubber lining is so shaped at its two ends as to form radially projecting collars **56'**. The collar **56'** situated at the upper end of the lining **56** in FIG. 5 engages in a recess **57** on the inner side of the end wall **47** and in a recess **58** in the end face of the part **40** of the wall of the housing and is tightly clamped between the end wall **47** and the part **40** of the cylindrical wall of the housing. Similarly, the collar **56'** at the other end of the rubber lining **56** is held in recesses **58'** and **57'** in the lower end wall of the part **40** of the cylindrical wall of the housing and in the flange **48** so as to be non-rotatable and axially and radially unshiftable. In this example the rubber lining **56** is additionally secured against axial and radial shifting by a flange **59** on the inner side of the part **40** of the cylindrical wall of the housing and by an internal extension of the flange **48**.

The outer wall surface of the rubber lining **56** between the end collars **56'** is freely spaced from the inner wall surface of the part **40** of the cylindrical wall and defines, together with this part **40**, an elongated narrow annular space **60**. The annular space **60** communicates with a compressed-air pipe **61** which is connected to a bore formed in the central region of the part **40** of the wall of the housing. The compressed-air pipe **61** extends from a compressed-air source, e.g. from an air compressor **62**, and a manually operable regulating member **63** which is constructed as a check valve is fitted in the compressed-air pipe **61**, the operation of which regulating member permits the air pressure acting on the rubber lining **56** to be regulated as desired.

In FIG. 5 the rubber lining **56** is shown in a condition in which it is not yet subject to the action of compressed air. In this case a section **64'** of the inner wall surface **64** of the rubber lining **56** which is of conical shape to conform to the conicalness of the outer wall surface of the rotor **35** is positioned opposite to the outer wall surface of the rotor **35** at a free distance therefrom. The narrow conical annular gap x facilitates setting the dressing apparatus going in so far as not too great a resistance counteracts the stream of the fiber-liquid mixture. As soon as the fiber-liquid mixture is imparted the desired flow corresponding to a helical course, compressed air is admitted into the annular space **60**. This causes the rubber lining **56** to be curved inwardly and to be pressed with the conical section **64'** of its inner wall surface against the outer wall surface of the rotor **35** without leaving a gap. Regulating the amount of the compressed air acting on the rubber lining **56** permits the bearing pressure of the lining against the rotor **35** to be varied as desired and to be regulated in such a manner as is required in view of the hydraulic pressure with which the fiber-liquid mixture is forced by the pump **14** through the dressing apparatus and in view of the speed of the shaft **5** required to open up the crude asbestos material in the best possible manner.

The fiber-liquid mixture is, in a similar manner as in

the dressing apparatus according to FIG. 1, sucked by the motor-driven feed pump **14** out of a storage container **13** and conveyed through the pipe conduit **12** which is connected by a flanged joining piece **90** to a connection piece **91** welded to the upper end wall **47** of the housing and provided with a flange **91'**, into the dressing apparatus at the upper end thereof. After the fiber-liquid mixture has been forced through between the conical inner wall surface of the rubber lining **56** blown up inwardly by compressed air and the conical outer wall surface of the rotor **35** rotated by the shaft **5**, it passes into a chamber **84** of the housing constituted by the parts **47**, **40**, **41** and **41'**, which chamber is situated below the great base circle of the conical rotor **35** closed by the annular disk **39**. The fiber-liquid mixture then leaves the chamber **84** through a lateral connection piece **65** on the housing to flow either through the pipe conduit **24** to a further processing station or through the two-way cock **25** and the pipe conduit **26** back to the storage container **13**.

The conical section **64'** of the inner wall surface of the rubber lining **56**, which constitutes the working surface of the rubber lining, is subjected during the operation of the dressing apparatus to unavoidable abrasion wear. Therefore, a device is provided by means of which the shaft **5** can be readjusted in axial direction in accordance with the respective degree of wear of the rubber lining.

The readjusting device consists of a threaded spindle **66** which is screwed into a tapped hole in a plate **67**. The plate **67** is welded to a plate **68** disposed perpendicularly to the plate **67** and having a longitudinal rib **68'**, which plate **68** in turn is screwed to a plate **69** welded to a rail **33** of the supporting structure. A handwheel **70** is fixed and a locking lever **71** screwed on the free end of the spindle **66**. When, by operating the handwheel **70**, the shaft **5** has been brought into a position in which the conical section **64'** of the inner wall surface **64** of the rubber lining **56** not yet acted upon by compressed air has the proper spacing from the outer wall surface of the conical rotor **35**, the locking lever **71** is screwed upwardly against the plate **67** and thereby the shaft **5** locked in its adjusted position.

The threaded spindle **66** is connected to the shaft **5** by a ring **72** which is fixed on the lower end of the shaft **5** by a cylindrical head screw **73**. Accommodated in an enlarged section of the bore in the connecting ring **72** are the outer edges of the two races of a thrust ball bearing **74** and the outer edge of a stepped spacer **75** by means of which the ball bearing **74** is supported against a shoulder **66'** on the threaded spindle **66**. A castle nut **76** screwed on the upper threaded section of the spindle **66** of reduced diameter holds, with the aid of an annular disk **77**, the ball bearing **74** and the spacer **75** in position on the spindle **66** so that they are axially unshiftable. Formed in the enlarged section of the bore in the connecting ring **72** in a place below the radially projecting portion of the spacer **75** is an annular groove in which a spring ring **78** is inserted which fixes the ball bearing **74** and the spacer **75** on the connecting ring **72**.

The lower half of the connecting ring **72** is surrounded by a cylindrical housing **79** which is welded to the plate **67** and to the longitudinal rib **68'** of the plate **68**. A felt sealing ring **80** inserted in the housing **79** prevents dirt and moisture from getting to the parts of the adjusting device mounted within the connecting ring **72**.

For limiting the axial adjustability of the shaft **5**, two slide rings **81** are arranged on the shaft which bear against different sides of the two bearings **31**. Each slide ring **81** has an opening **82** which is in the form of an oblong hole and in which the cylindrical head **83'** of a cylindrical head screw **83** screwed into the shaft is positioned. When the head **83'** of the cylindrical head screw **83** butts against the one end or the other end of the opening **82** in the slide ring **81**, the shaft **5** has reached during its adjusting movement its extremely advanced position or its extremely retracted position.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive.

I claim:

1. An apparatus for dressing crude asbestos separated from the source rock and being in the form of fibrous bundles suspended in a liquid, comprising a housing, an inlet on said housing for admitting the fiber-liquid mixture into said housing, an outlet on said housing for discharging the fiber-liquid mixture from said housing, a motor-driven shaft rotatably mounted within said housing, a rigid working surface on said shaft, a lining of elastically yielding material inflatable with compressed air in said housing fixedly held on the wall of said housing and closely engaging said working surface on said shaft when in fully inflated condition, a regulable feed pump for forcing with a controllable hydraulic pressure the fiber-liquid mixture admitted through said inlet into said housing in a circulating flow between said rigid working surface on said shaft and a counterfriction surface of said lining while subjecting the fibers to friction and continuously bending them in constantly varying directions, and for conveying the fiber-liquid mixture to said outlet on said housing, a compressed-air pipe for subjecting said lining to the action of compressed air, and a regulating member fitted in said compressed-air pipe and permitting, when operated, the bearing pressure of said lining surrounding said working surface on said shaft to be adjusted to the frictional effect and the intensity of bending the fibers which result in completely opening up the fibers.

2. An apparatus as claimed in claim **1**, wherein the rigid working surface on the shaft is constituted by the surface of the shaft.

3. An apparatus as claimed in claim **1**, wherein the rigid working surface on the shaft is constituted by the outer wall surface of a rotor which is mounted on the shaft.

4. An apparatus as claimed in claim **1**, wherein the inflatable lining consists of rubber.

5. An apparatus as claimed in claim **2**, wherein the housing is cylindrical, a removable partition wall is provided in the housing the inflatable lining is in the form of an annular tube and is inserted in the housing so as to engage with its outer wall surface the inner surface of the wall of the cylindrical housing and a connecting piece is provided on the inflatable lining for the connection of the compressed-air pipe, which connecting piece extends through a bore in the wall of the housing.

6. An apparatus as claimed in claim **5**, wherein at least one helical flat rib is provided on the shaft, the inflatable lining in the form of an annular tube surrounds the shaft with a smooth inner wall surface, a packet of annular disks is arranged in the housing on the downstream side of the inflatable lining, the packet of annular disks is composed of rigid annular disks with a bore diameter greater than the diameter of the shaft and yieldable annular disks of elastic material with a bore diameter approximately equal to the diameter of the shaft, the rigid annular disks are arranged so as to alternate with the yieldable annular disks thereby to form annular chambers, a cover closes the housing on one side and presses against the packet of annular disks, screw bolts are provided to connect the cover to the housing and nuts are screwed on the screw bolts and permit the bearing pressure of the walls of the holes in the yieldable annular disks against the shaft to be regulated by appropriately tightening the nuts on the screw bolts.

7. An apparatus as claimed in claim **6**, wherein the yieldable annular disks consist of rubber.

8. An apparatus as claimed in claim **3**, wherein the inflatable lining is in the form of a thick-walled solid annular body with collars at both ends, the housing has a cylindrical wall composed to two wall sections of dif-

ferent wall thicknesses, two flanges are formed on the two ends of the wall section of increased wall thickness, one flange is formed on the wall section of smaller wall thickness which forms an extension of the wall section of increased wall thickness and two end walls close the housing at the two ends thereof, the inflatable lining being clamped with its end collars within the section of the cylindrical wall of the housing of increased wall thickness between the flange on the one end of the wall section of increased wall thickness and the end wall at one end of the housing and between the flange on the other end of the wall section of increased wall thickness and the flange on the wall section of smaller wall thickness.

9. An apparatus as claimed in claim **8**, wherein the

rotor has a conical outer surface and only a section of the smooth inner wall surface of the inflatable lining inserted in the housing is of conical shape to conform to the conical outer surface of the rotor surrounded by the lining.

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