Jan. 14, 1958 C. V. SMITH 2,819,846

PROCESS OF AND APPARATUS FOR SEPARATING ASBESTOS FIBRE FROM ROCK AND FOR CLEANING THE FIBRE

Filed Feb. 15, 1954 2 Sheets-Sheet 1

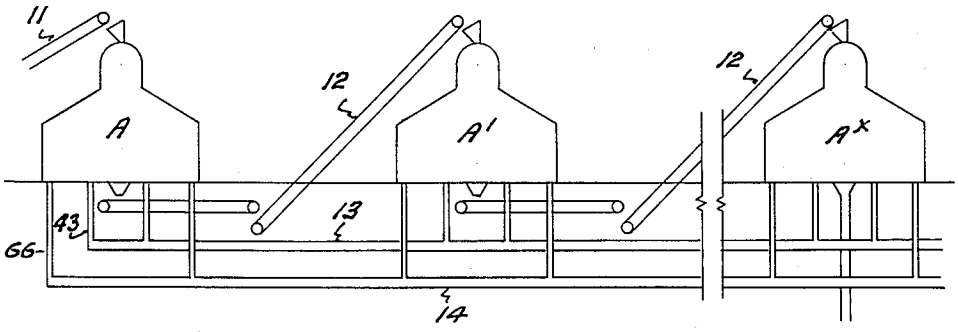


FIG. 1

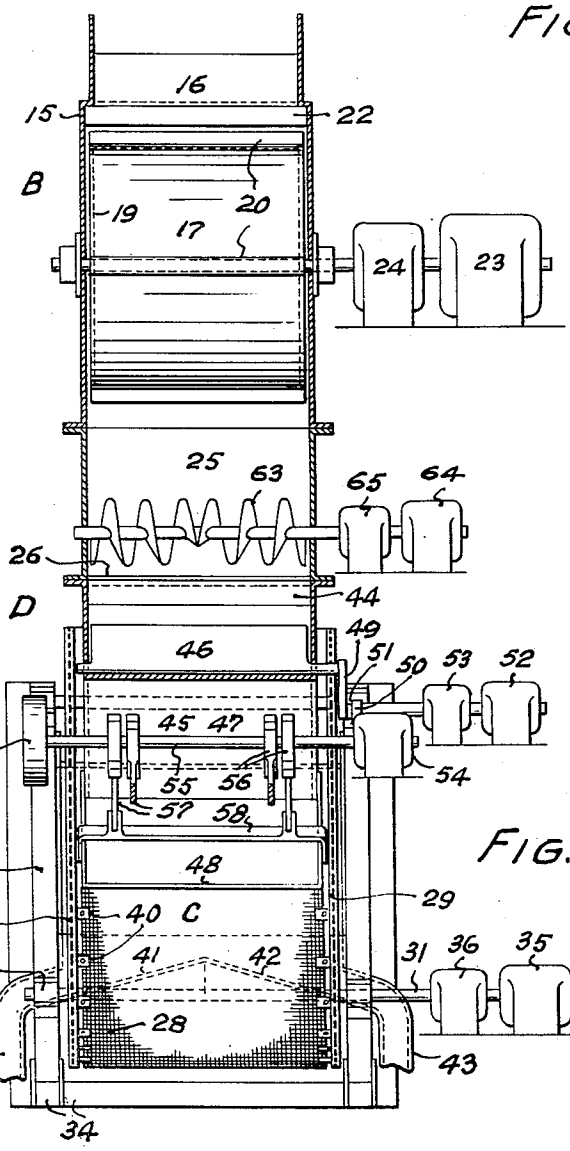


FIG. 3

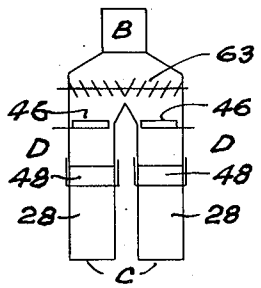


FIG. 5

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FIG. 4

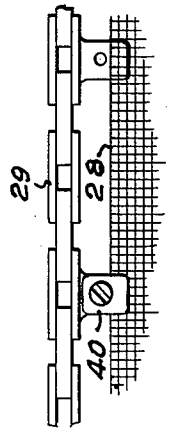


FIG. 2

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PROCESS OF AND APPARATUS FOR SEPARATING ASBESTOS FIBRE FROM ROCK AND FOR CLEANING THE FIBRE

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Application February 15, 1954, Serial No. 410,408

30 Claims. (Cl. 241—4)

This invention relates to improvements in process of and apparatus for separating asbestos fibre from rock and for cleaning the fibre and the primary object of the invention is to obtain better separation and cleaning of the fibre than has been heretofore possible and to effect the said separation and cleaning with less expenditure of power and in suchwise as to enable use of simpler, more compact and less expensive apparatus than heretofore.

A further object is to effect the separation and cleaning of asbestos fibre without use of air blasts or suction.

Various other objects and the advantages of the invention may be ascertained from the following description and the accompanying drawings.

Broadly speaking, the invention consists as to process in impacting crushed asbestos ore at high velocity against a disintegrating means for separation of fibre from rock and for opening of the separated fibre and then discharging the resulting material intermittently to the lower end of a sharply inclined, rapidly moving, vibrated screening belt, the inclination of the belt and its lineal speed being such that rock particles are discharged at the lower end of the screening belt and asbestos fibre at the upper end, and the duration of discharges to the belt and the time intervals between them being so related to the inclination of the belt and to its lineal speed that the lower end portion, at least, of the belt is substantially cleared of material of one discharge before receiving material of the next discharge; and consists as to apparatus in a fiberizer comprising a roughened disintegrating surface and rotating means to impel crushed ore at high velocity against said disintegrating surface, a sharply inclined, rapidly moving, vibrated, foraminous screening belt and means for feeding material intermittently from the fiberizer to the lower end of said belt.

In greater detail, the invention consists as to process in the steps and combinations of steps herein disclosed and as to apparatus in the instrumentalities and combinations thereof herein disclosed, together with all such modifications of such steps and instrumentalities and substitutions of equivalents therefor as are within the scope of the appended claims.

I have ascertained as result of extensive experiments that perfection of separation of asbestos fibre from rock and classification of the separated fibre, rock and fines are to a large extent dependent on high speed of movement of the material and that speed of movement sufficient for greatly improved separation and classification can be imparted mechanically to the material and improved separation and classification of fibre can be effected without resort to air blasts or to suction, thus effecting a very considerable saving of power. I have further ascertained that in the use of travelling inclined screens to classify asbestos fibre, rock particles of substantial size and fines and dust, a superior classification results if the mixed materials are fed to the screen intermittently in such amounts and with such time intervals between feedings with relation to the inclination and lineal speed of the screen, that the screen may substantially clear itself between feedings, at least at the point where material is discharged onto it, and that under such conditions the rate of classification per unit volume of material fed is higher than the similar rate of classification if material is fed continuously at the same rate as during each of the intermittent feedings.

Although the classification of material by screening according to this invention is nearly perfect, it is not to be expected that a complete separation of fibre from rock will be effected in a single impact disintegrating, or fiberizing, operation; wherefore I contemplate passing the material through a series of similar stages in each of which, after the first, the residue of fibre-containing rock discharged from the previous stage is subjected to fiberizing and the resulting material is classified. As the apparatus used in each stage is relatively small and inexpensive and requires but relatively small expenditure of power, the number of stages may be such as to effect a substantially complete recovery of fibre as heads and fines, leaving substantially no fibre in the final rock residue. While two or three stages are usually sufficient, I do not limit myself to this number. It will be understood that the number of stages necessary is influenced by the character of the fibre and of the rock in which it is found.

In the accompanying drawings which illustrate that embodiment of the invention now preferred and some modifications thereof but to the details of which embodiment the invention is not confined:

Fig. 1 is a diagram illustrating a series of substantially similar apparatus units and conveyor means for transporting material.

Fig. 2 is a side elevation, partly in vertical section, of one of the units of Fig. 1, various duplicating parts having been omitted for clarity.

Fig. 3 is a vertical cross-sectional view of the unit of Fig. 2, at approximately the line 3—3 of that figure.

Fig. 4 is a plan view of a fragment of screening belt illustrating the supporting means thereof.

Fig. 5 is a diagram illustrating modifications.

Referring more particularly to the drawings, and especially to Fig. 1 thereof, any desired number of processing units, designated A, A^1—A^x, are arranged in series and associated with a conveyor means **11** bringing crushed asbestos ore to unit A of the series, and with any suitable sort of conveyor means, designated **12**, for moving incompletely treated material from one unit to the next in the series, and are also associated with any suitable sort of conveyor means, designated **13**, for collecting fines and dust from all units of the series, and any suitable sort of conveyor means, designated **14**, for collecting asbestos fibre from all units of the series and for transporting it to a finishing station. The units are not necessarily arranged all at one elevation but may be at different elevations so as to permit of movement of material by gravity.

Each of the treating units may be substantially as illustrated in Figs. 2 and 3 and comprises a fiberizer B, fibre and rock classifying means C and means D to feed material from the fiberizer to the classifying means. Preferably, movement of material is by gravity from the fiberizer through the feeding means to the classifier. As will be seen, the fiberizer and the feeding means serve two classifying means.

The fiberizer B comprises a casing **15**, preferably semi-cylindrical in its upper part, having a narrow top inlet **16** preferably extending from end to end of the casing, containing an axially horizontal, rotatable, cylindrical impeller **17** centered under the inlet and a stationary disintegrator **18** suitably spaced from the impeller, at one side thereof.

The impeller preferably comprises a cylindrical drum **19**, rotatable about its axis, having a plurality of projections **20** from its cylindrical surface. These projections

are preferably square bars extending longitudinally of the drum from end to end thereof, parallel with the drum axis and spaced equidistantly around the drum. I now prefer to use four such bars but may use either more or less. The bars are preferably composed of wear resistant material, such as manganese steel, and are releasably attached to the drum so that they may be readily adjusted or replaced when worn.

The disintegrator **18** is a curved plate of wear resistant material, such as manganese steel, rigidly mounted in the casing with its concave side adjacent the impeller and is co-extensive with the length of the impeller. The disintegrator extends from approximately the inlet **16** for a suitable distance around the impeller, for example, between 90° and 120°. The inner or concave surface of the plate is preferably concentric with the impeller but may be otherwise if desired. The concave surface of the plate **18** is provided with a plurality of relatively closely spaced, longitudinal ribs **21**, preferably triangular in cross-section and parallel with the impeller projections **20**. At the inlet of the casing a deflector plate **22** is provided and serves to direct incoming material in a path approximately tangential to the cylindrical surface of the impeller drum and in the direction of its rotation, which is toward the disintegrator. The impeller is driven by a motor **23**, either directly or through any suitable speed change device **24**.

The lower part **25** of the casing **15** is of hopper form converging toward the vertical plane P of the impeller axis and having a narrow outlet **26** extending from end to end of the casing and being substantially co-extensive with the length of the impeller. Near the outlet **26** and on the opposite side of said plane P from the disintegrator, the casing wall is offset outwardly to provide an internal pocket **27** paralleling the outlet and having, preferably, a horizontal wall and a vertical wall.

The means C for classifying long fibre, fines and rock and for cleaning the long fibre comprises, essentially, a pair of endless wire mesh screening belts **28** arranged with their upper passes sharply inclined from end to end and laterally horizontal, and means to support and move said belts in suchwise that their upper passes move upwardly. Preferably, the two belts **28** are oppositely inclined and arranged in line with their lower ends adjacent, as shown in Fig. 2, but they may be arranged side by side, as shown diagrammatically in Fig. 5.

Irrespective of the relative arrangement of the two screening belts, each is preferably connected at its edges to chain belts **29** trained over sprockets **30** mounted on shafts **31** journalled in bearings **32** mounted on frame side members **33** which are, in turn, mounted on a base frame **34**. The frame members **33** may be adjustable in the base frame **34** in suchwise as to enable the inclination of the upper pass of the screening belt **28** to be altered. One shaft **31** pertaining to each screening belt is driven by a motor **35**, either directly or through any suitable speed changing device **36**. Preferably, each belt **28** has associated with the under side of its upper pass one or more beaters **37** adapted to vibrate the belt in a direction normal to its plane. The beaters are preferably of rotating multi-blade type, mounted in bearings **38** on the frame members **33** and operated by contact with the belt or by pinions **39** meshing with one of the chain belts **29**. With this arrangement, the beater blade edges engaging the screening belt move at substantially the same speed as the belt so that there is little or no wear of the belt. The screening belts may be connected to the chains in any suitable way, as by means of clamps **40** carried by the chains and gripping the edge portions of the belts, as shown in Figs. 3 and 4. It will be understood that rollers (not shown) may be mounted on the shafts **31** between the sprockets to support the screening belts.

An inclined collecting pan **41** of at least the width of the screening belt is carried by the frame members **33** associated with each belt between the upper and lower passes of the belt and extends from nearly the lower to nearly the upper ends of the upper pass of the belt. At its lower end portion the pan is laterally inclined, as at **42**, to direct material collected in the pan into conduits **43** descending outwardly of the frame and leading to the conveyor means **13**.

It will be observed that the supporting frames **33**, **34** of the two screening belts are quite separate whereby they may be so positioned as to locate the lower ends of the screening belts at any desired distance apart. Also, either frame with the screening belt thereon may be readily withdrawn and replaced by another, thereby to minimize loss of running time of the whole installation if repairs to any screen unit should become necessary.

The feeding device D comprises, essentially, a conduit **44** leading downwardly from the outlet **26** of the fiberizer B to the upper ends of a pair of chutes **45** positioned to deliver material onto the lower ends of the screening belts, respectively, and a gate **46** between the conduit **44** and the chutes **45** movable to direct material into the chutes alternately. In the embodiment illustrated in Fig. 2, in which the conduit **44** is vertically above the space between the adjacent lower ends of the aligned screening belts, the chutes **45** comprise upper stationary parts **47** disposed in downwardly diverging relation to one another, and lower movable parts **48** hinged to the upper parts and disposed in downwardly converging relation to one another and terminating vertically above the lower end portions of the screening belts.

The gate **46** may be of any suitable form. The form now preferred is that of a simple plate of length and width sufficient to cover the upper ends of the chutes **45** and rockable about an axis in its lower edge portion, which axis is located at approximately the intersection of the lower walls of the chutes. Any suitable means may be provided for oscillating the gate about the said axis. One suitable means comprises an arm **49** located externally of the chutes and rigidly connected to the gate; a rotating crank **50**; and a link **51** connecting the free end of the arm to the crank. The crank may be rotated by any suitable means such as a motor **52** connected to it through any suitable sort of speed change device **53**.

If desired, any suitable means may be provided for vertically oscillating the lower parts **48** of the chutes. One suitable means comprises a driving motor **54**, a shaft **55** suitably connected thereto and carrying eccentrics **56** which are connected by links **57** to yokes **58** spanning the free ends of the movable chute parts **48**. For purposes of illustration, the throw of the eccentrics has been exaggerated and it is to be understood that they preferably have very small throw, for example between one-eight and one-quarter of an inch, so that the movement imparted to the chute parts, or spouts, **48** is substantially no more than vibration. A fly wheel **59** may be provided on the shaft **55**.

As will be seen from Fig. 2, the spouts are so inclined and so located with reference to the screening belts that the planes of the bottoms of the spouts, if projected, would intersect the screening belts substantially at the lower ends of the upper passes thereof, for example at a transverse line indicated by the point **60**. It will also be seen that the lower ends of the spouts **48** are located vertically above transverse lines on the screening belts located some distance up from the lower ends of the upper passes of the belts, as indicated by the point **61**.

If desired, two sets of aligned screening belts, each set exactly as shown in Fig. 2, may be arranged side by side, as shown in Fig. 5, and receive the output of a single fiberizer, each set of screening belts having its own feeding means D. In such case it will be necessary to provide a right-and-left hand feed worm **63** between the fiberizer and the gates, the said worm being rotated in such direction as to feed from its center toward its ends. The worm may be operated by a motor **64** through a speed change device **65**. The use of a feed worm, as

above described, is not confined to installations having two sets of screening belts arranged side by side and may be used with a single set of screens, especially if these are wider than the length of the fiberizer outlet, to ensure distribution of material uniformly across the width of the screening belts.

Chutes 66 may be located to receive fibre discharged from the upper ends of the screening belts and to conduct it to the conveyor means 14 or to other equipment.

Each classifying unit may be enclosed in a casing 67 to prevent escape of dust to the surrounding air.

While, for convenience of description, the driven elements of the apparatus have been described as if driven by individual motors and speed change devices, it will be understood that a single motor may serve to drive two or more elements through suitable speed change devices, such as belt drives. It is, however, preferred to use individual motors for the fiberizer and for each of the screening belts.

In carrying out the process of my invention, crushed asbestos ore is fed in a comparatively thin stream into the top of the fiberizer B and into the path of the bars 20 of the rapidly revolving impeller which project the ore at high velocity against the disintegrator 18, for example, at 200 feet per second. The ore is broken up, the fibre bundles freed from it and the fibre opened both by the impact of the impeller bars and by the impact of the material against the disintegrator. The material striking the disintegrator ribs 21 tends to be thrown back into the path of the impeller bars 20 a plurality of times during passage from top to bottom of the disintegrator. Particles of the material are also caused to impact on one another with considerable rubbing effect which not only separates fibre from rock but also opens the fibre bundles. The surface speed of the impeller 17 should increase as the rock particles are reduced and will, therefore, be progressively higher in successive stages; but it will be understood the preferred velocity for any given run of ore is governed to some extent by the fibre content and friability of the ore.

The fiberized material is thrown down from the impeller in the general direction of the hopper pocket 27, in which a normal accumulation of the material serves to cushion the impact of the descending material and to protect the hopper from wear. The fiberized material passes down through the conduit 44 and is directed by the oscillating gate 46 into the chutes 45, alternately. Passing down through the upper parts of the chutes in a relatively thin layer, the material enters the lower chute parts, or spouts, 48 and is thereby deflected toward the lower ends of the screening belts 28 in directions opposite to the movement of the upper passes of the belts. Owing to the inclination and location of the spouts, as already described, the heavier material, being relatively large particles of ore which have not been sufficiently fiberized, tends to overshoot the lower ends of the screening belts and to fall into the space between the adjacent ends of the belts and into the conveyor 12 for transport to the next unit of the series. This overshooting of the screening belts by the larger rock particles classifies and separates material which would not benefit from passage over the screening belts and also avoids belt wear by impact of such material. The fibre, the smaller, lighter particles of defiberized rock and the larger particles with fibre adhering do not have sufficient momentum to follow the same trajectory as the larger particles and fall onto the lower ends of the screening belts.

In passing through the chutes, the material changes direction by about 90° and thereby loses some velocity. Rapid vibration of the spouts 48 by the eccentrics 56 and links 57 overcomes any tendency of the spouts to become choked because of the reduced velocity of the material and also serves to shake the material into a relatively thin layer of substantially uniform thickness and to work the larger particles of rock to the upper surface of this layer so that they will be free to overshoot the ends of the screening belts, as aforesaid. To be effective, the vibration should be fairly rapid, for example, of the order of 10 to 20 cycles per second. The amplitude of the vibration should be quite small so as to avoid excessive elevation of the spouts and misdirection of the material, also the throwing out of material which it is desired to screen. An amplitude of movement which has been found satisfactory is between 3/16 and 3/8 of an inch.

Material falls from the spouts 48 onto the lower ends of the inclined, upwardly moving screening belts and is deposited in a relatively thin layer over substantially the full width of each of the belts, tending both to be carried up by the belts and to roll down the same. All the material deposited on the belts is initially carried up. Due to the vibration of the belts, larger and heavier particles of rock with fibre adhering thereto are worked to the upper surface of the layer of material and roll down the incline of the screen. During the rolling movement, fibre is separated from rock and the rock discharges from the lower ends of the screening belts. The free fibre and the fines and small rock particles are separated by the screening belts, the fibre being discharged from the upper ends of the belts and the fines and small rock particles passing through the belts into the collecting pans 41. The rock discharged at the lower ends of the screens is carried by the conveyor 12 to the next unit of the installation and the fines and long fibre pass to the conveyors 13 and 14, respectively. The screening belts move at speeds unusually high in the screening of asbestos fibre, for example, at 250 to 400 feet per minute and the inclination is, therefore, unusually great and is so related to the lineal speed of the screens that the resultant downrolling speed of the heavy rock particles is greater than the upward movement imparted to them by the screens. Screening belts which have been found satisfactory are woven of No. 18 wire with openings of .05 inch. Because of the vibration of the screening belts and the tumbling of material thereon, the fibre is very satisfactorily cleaned and is ready for grading.

Classification of material by the screening belts is greatly facilitated by the intermittent feeding of the material thereto which is, preferably, so related to the lineal speed and the inclination of the belts that the duration of each feeding operation is approximately the time required for material deposited on the lower ends of the belts to reach the upper ends thereof. Thus, for a belt having an effective screening length, or upper pass, of 10 feet and travelling 300 feet per minute, the duration of each feeding operation will be 2 seconds and the time intervals between successive feeding operations will each be 2 seconds. Under these conditions the screening belts substantially clear themselves between feeding operations and the rate of classification per unit weight of material in each feeding is increased as compared with the rate of classification per unit weight of material if continuously fed. The durations of the feeding operations and of the time intervals between them are controlled by the frequency of oscillation of the gate 46, which frequency is thus related to the lineal speed of the screening belts and the effective screening lengths thereof. For a given length of belt, the durations of feedings and the intervals between them should be reduced if the lineal speed of the belts is increased.

By feeding material to two screening belts alternately, the throughput of material can be greater than would result from continuously feeding a single belt and a better classification obtained. Operating as aforesaid, the fibre discharged from each stage of the process is substantially completely cleaned and ready for grading. Also, the heavier rock particles discharged from the lower ends of the screening belts have substantially no free fibre adhering to them, thus avoiding damage to and loss of fibre due to needless reprocessing.

By processing the material in thin streams and at high speed I obtain a high efficiency. I have found that using an impeller approximately 4 feet in diameter and rotating 1000 revolutions per minute it is possible to very satisfactorily fiberize in excess of 25 tons of ore per hour per foot of impeller width. Also, using screening belts each having an effective screening length of 10 feet and inclined 35° to 40° from horizontal and travelling at approximately 300 feet per minute, and feeding material to them alternately during 2-second periods with 2-second time intervals between feedings, it is possible to satisfactorily treat considerably in excess of 10 tons of fiberized ore per hour per foot of screen width. The power required for fiberizing and for screening the output of the fiberizer was between 15 and 20 H. P. per foot of impeller width.

It will thus be seen that my invention affords a high speed fiberization of ore and a high speed subsequent treatment in which unfiberized and fiberized ore are classified and the fiberized ore then further classified.

As has been previously pointed out, the separation and cleaning of asbestos fibre according to this invention is effected without use of air blasts or suction, with result that the body of air within the apparatus is relatively quiescent. Under this condition, dust and fines which have been mechanically separated from the opened fibre gravitate from the fibre instead of being carried along with it, as occurs in any method in which the material is subjected to air blast or suction during, at least, the initial fiberizing stage.

Having thus described my invention, I claim:

1. A process of separating asbestos fibre from rock which comprises, projecting crushed asbestos ore at high velocity against a roughened disintegrating surface with fiberizing effect; advancing the fiberized material toward a classifying zone while dividing the material into portions and feeding the portions successively to the classifying zone with such interval of time between each feeding and the next that each feeding will be substantially completely classified during such interval; and causing the fibre to move rapidly upwards along an inclined path in said classifying zone at such speed that it separates from the rock.

2. A process of separating asbestos fibre from rock which comprises, projecting crushed asbestos ore at high velocity against a disintegrating surface, with fiberizing effect; transferring the fiberized material to a classifying zone; moving the material in a thin layer rapidly upwardly along a sharply inclined path in said zone while vibrating the material of the layer, the inclination of the path and the speed of upward movement of the material along said path being such that during the time the material remains in the classifying zone the force of gravity acting on incompletely fiberized material eventually overcomes the force moving the material upwardly while the upward movement of the separated fibre overcomes the force of gravity acting thereon; and separately collecting the unfiberized material and the fibre.

3. A process of separating asbestos fibre from rock and opening and cleaning the fibre, in which the material is subjected to a succession of treatments according to claim 2 and in each of which after the first, rock and incompletely fiberized material collected from the previous treatment is projected at higher velocity than in the preceding treatment.

4. A process of separating asbestos fibre from rock, fines and dust which comprises, feeding crushed asbestos ore in a relatively thin, wide stream; subjecting the material in said stream to a succession of impacts along lines transverse of the stream, with fiberizing effect and serving to project the material at high velocity; abruptly interrupting the movement of the projected material along a plurality of lines substantially parallel with said lines of impact and spaced along and transverse of the direction of movement of the material, with further fiberizing

effect; feeding the product of said fiberizing operations in a thin stream to a classifying zone; moving the fibre and partly fiberized material, fines and dust rapidly upwards along a sharply inclined path in said zone while vibrating the material to effect a gravity separation of fibre from partly fiberized material and from fines and dust; maintaining a relatively quiescent body of air around the material undergoing the aforesaid treatments, thereby to facilitate separation of dust and fines from fibre; and separately collecting the fibre, the unfiberized material and the dust and fines.

5. A process of separating asbestos fibre from rock and of opening and cleaning the fibre in which the material is subjected to treatment in a succession of stages each according to claim 4 in each of which, after the first, the unfiberized and the partly fiberized material collected from the vibratory separation of the preceding stage is projected at higher velocity than in the preceding stage.

6. A process of separating asbestos fibre from rock and cleaning the fibre, which process comprises, projecting crushed asbestos ore at high velocity against a rigid disintegrating surface, with fiberizing effect, producing a mixture of freed fibre, large particles of unfiberized or incompletely fiberized material, and small particles comprising dust and fines; forming the mixture into a thin layer and directing the layer downwardly along an inclined path toward a classifying zone while vibrating the layer to effect division thereof into an upper portion consisting of larger, heavier particles of unfiberized and incompletely fiberized material and a lower portion consisting of freed fibre, smaller particles of unfiberized and incompletely and small particles being dust and fines resulting from the disintegrating step, and so directing the layer that the said upper part thereof is directed past the classifying zone while the material of the lower part is directed into said zone; classifying the material entering said classifying zone; and separately collecting the said smaller particles of unfiberized and incompletely fiberized material, the freed fibre, and the small particles comprising dust and fines.

7. A process according to claim 6 in which the classification is effected by passing the material in a thin layer upwardly along an inclined path while vibrating the layer.

8. A process of separating asbestos fibre from rock which comprises, feeding the material in a thin stream; subjecting the material in said stream to a succession of impacts along lines transverse of the stream, with fiberizing effect and serving to project the material at high velocity; abruptly interrupting the movement of the projected material along a plurality of line spaced along and transverse of the direction of movement of the material, with further fiberizing effect; feeding the fiberized material in a thin stream to a classifying zone and interrupting the stream at regularly spaced intervals and for such times that material fed immediately prior to each such interruption will be substantially completely classified during the interruption; and causing the fibre to move upwards along an inclined path in said classifying zone at such speed as will overcome the force of gravity acting on the fibre but below the speed at which the force of gravity acting on the rock would be overcome.

9. A process of separating asbestos fibre from rock which comprises, fiberizing the material; feeding the fiberized material in a thin stream toward a classifying device including a plurality of classifying elements, while dividing the stream into portions and feeding the portions to the classifying elements with time intervals between successive feedings to each classifying element such that each portion of material is substantially completely classified during the immediately ensuing time interval; and moving the material upwardly along an inclined path in each said classifying element at such speed having regard to the inclination of the path and the force of gravity that the fibre will continue to move upwardly while the rock will eventually move downwardly.

10. A process of separating asbestos fibre from rock which comprises, fiberizing the material; feeding the fiberized material in a thin stream toward a classifying device while vibrating the stream to effect layering of fiberized and unfiberized material; so directing the stream that unfiberized material of an upper layer overshoots the classifying device while fiberized material of a lower layer is deposited on the classifying device; interrupting the stream to provide time spaced feeding periods to said classifying device of such duration that the material deposited during each feeding period is substantially completely classified during the immediately succeeding interval between feedings.

11. A process of separating asbestos fibre from rock which comprises, fiberizing the material; feeding the fiberized material in a thin stream toward a classifying device including a pair of classifying elements while dividing the stream into portions and vibrating each portion to effect a gravity separation of the material into an upper layer of unfiberized material and a lower layer of fiberized material; directing the portions of material toward the classifying elements alternately in such-wise that the material of each upper layer overshoots a classifying element while the material of each lower layer is deposited on a classifying element; the periods during which material is so deposited on each classifying element and the time intervals between them being such that each deposit of material is substantially completely classified during the immediately ensuing time interval between feedings.

12. A process of separating asbestos fibre from rock which comprises, fiberizing crushed asbestos ore; feeding the fiberized material in thin streams to the lower ends of two sharply inclined, rapidly ascending screening belts alternately, the periods between feedings to a belt being such that in each such period the material deposited during the immediately preceding feeding period is substantially completely classified.

13. A process of separating asbestos fibre from rock which comprises, fiberizing crushed asbestos ore; feeding the fiberized material in thin streams to the lower ends of two sharply inclined, rapidly ascending screening belts alternately, the periods between feedings to a belt being such that in each said period the material deposited during the immediately preceding feeding period is substantially completely classified; vibrating the material in course of feeding to the belts to effect a gravity separation thereof into an upper layer of unfiberized material and a lower layer of mainly fiberized material and so directing the material that the upper layer thereof overshoots the lower ends of the screening belts; and vibrating the material on each said belt to effect a separation thereof into an upper layer of material which will roll down the inclination of the belt and a lower layer which will, in part, be carried up by the belt and, in part, pass through the belt.

14. Apparatus for separating asbestos fibre from rock comprising, in combination, a fiberizer; a sharply inclined, ascending screening belt; means to feed material from the fiberizer intermittently to the lower end of said belt; and means to move said belt at high lineal speed.

15. In combination with apparatus according to claim 14, means for vibrating said feeding means and material passing therethrough to effect a gravity layering of the material prior to discharge to said screening belt, said feeding means being disposed to so direct material toward the screening belt that the upper layer of material will overshoot the lower end of the belt while the lower layer will fall on the lower end of the belt.

16. In combination with apparatus according to claim 14, means for vibrating the screening belt and material thereon to effect a gravity layering of the material, the inclination of the belt being so related to the lineal speed thereof that the material of the upper layer will roll down the belt and discharge at its lower end while some of the material of the lower layer will be carried up and discharged at the upper end of the belt and other of the material will be discharged through the belt.

17. Apparatus according to claim 14 in which the feeding means includes a chute movable in part at least in a vertical plane; a shaft; eccentric means on said shaft; operative connection between said eccentric means and said chute; and means to rotate said shaft at high angular speed.

18. Apparatus for separating asbestos fibre from rock comprising, in combination, a fiberizer; a pair of sharply inclined, ascending screening belts; means to feed material from the fiberizer to the lower ends of said belts alternately; and means to move said belts at high lineal speed.

19. Apparatus according to claim 18 in which the feeding means includes a conduit leading down from the fiberizer; a pair of inclined, downwardly diverging chutes leading from the lower end of said conduit; an oscillatable gate between said conduit and said chutes; and means to oscillate said gate to communicate the chutes alternately with the conduit.

20. Apparatus according to claim 18 in which the two screening belts are oppositely inclined and arranged with their lower ends adjacent and in spaced relation.

21. Apparatus for separating asbestos fibre from rock comprising, in combination, a casing having a top inlet; an axially horizontal drum rotatably mounted in said casing; bars mounted on said drum and extending longitudinally thereof; a curved plate mounted in the casing having its concave surface facing and spaced from the drum and formed with ribs projecting toward the drum and substantially parallel with the drum bars; a sharply inclined, ascending screening belt; means to feed material passed between said drum and said plate intermittently to the lower end of said screening belt.

22. Apparatus for separating asbestos fibre from rock comprising, in combination, a casing having a top inlet; an axially horizontal drum rotatably mounted in said casing; bars mounted on the surface of said drum, extending longitudinally of the drum; a curved plate mounted in the casing having its concave surface facing and spaced from the drum, said plate extending between one-quarter and one-third of the way around the drum and being formed with ribs projecting toward the drum and substantially parallel with the drum bars; a pair of sharply inclined, ascending screening belts; and means to feed material passed between said drum and said plate to said belts alternately.

23. Apparatus for separating asbestos fibre from rock and for cleaning the fibre comprising, in combination, a fiberizer; a sharply inclined screening belt; means to move said belt at high lineal speed; means to feed material from said fiberizer to the lower portion of said screening belt comprising a downwardly inclining chute and means to vibrate said chute in a direction approximately normal to its plane to effect separation of material thereon into an upper layer of larger, heavier particles and a lower layer of fibre and smaller particles, the inclination of said chute being such that the material of said upper layer will overshoot the lower end of the screening belt while the lower layer of material will fall on the lower end of the belt.

24. Apparatus according to claim 23 including means to vibrate the screening belt with effect to separate material thereon into an upper layer of larger, heavier particles and a lower layer of fibre and small particles, and in which the inclination of the screening belt is so related to its lineal speed that the material of the upper layer will roll down the belt and discharge at its lower end while the material of the lower layer will be carried up by the belt and discharged in part at the upper end thereof and in part through the belt.

25. A process of separating asbestos fibre from rock,

fines and dust, which process comprises projecting crushed asbestos ore at high velocity against a disintegrating surface, with fiberizing effect producing a mixture of freed fibre, incompletely fiberized ore, rock, dust and fines; feeding the mixture intermittently to a classifying zone; moving the material in said zone upwardly along an inclined path at such speed having regard to the inclination of the path and the force of gravity that the freed fibre continues upwardly while the incompletely fiberized ore and the rock are eventually moved downwards by gravity; and collecting the freed fibre at the upper end of said path and the incompletely fiberized ore and the rock at the lower end of said path.

26. A process of separating asbestos fibre, rock, fines and dust, which process comprises projecting crushed asbestos ore at high velocity against a rigid disintegrating surface, with fiberizing effect producing a mixture of freed fibre, large particles of unfiberized or incompletely fiberized ore and small particles comprising dust and fines; dividing the mixture into portions and feeding the portions into a classifying zone at intervals spaced as to time; moving the portions of mixture in spaced relation in said zone at high lineal speed upwardly along a sharply inclined path while vibrating the portions of mixture; the point in said path at which the mixture portions are fed thereto, the inclination of the path and the lineal speed of the material in said path being such that a gravity classification of the material takes place; collecting the fibre at the upper end of the path, the unfiberized and incompletely fiberized material at the lower end of the path and the dust and fines between the lower and upper ends of the path.

27. A process according to claim 26 in which the portions of material are fed to the inclined path between the lower end thereof and a point approximately midway between the lower and the upper ends of the path.

28. A process for separating asbestos fibre from rock, fines and dust, which process comprises projecting fibre-bearing rock at high velocity against disintegrating surfaces in a succession of steps with production in each step of a mixture of fibre-bearing rock, freed fibre, defiberized rock, fines and dust; passing the product of each step through a classifying zone and therein effecting a gravity separation of freed fibre from the other constituents of the mixture; separately collecting the fibre-bearing rock, the freed fibre and the fines and dust and passing the fibre-bearing rock to a succeeding step for further disintegration while separately withdrawing the freed fibre and the dust and fines.

29. A process according to claim 28 in which the gravity separations are effected by causing the mixture of fibre-bearing rock, freed fibre, defiberized rock, fines and dust to move initially upwards at high speed along a sharply inclined path, the inclination of which and the speed of movement of the material being so related to the force of gravity that the freed fibre continues upward movement in said path while the fibre-bearing rock and defiberized rock ultimately move downward in said path.

30. Apparatus for separating asbestos fibre from rock and for cleaning the fibre, comprising a fiberizer; a sharply inclined, ascending screening belt; means to feed material intermittently to said belt between the lower end thereof and a point approximately midway between the lower and upper ends of the belt; means to move said belt at high lineal speed; means at the upper end of the belt to collect fibre; means at the lower end of the belt to collect rock; and means beneath the belt to collect fines and dust which pass through the belt.

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