March 15, 1960 M. E. MENCIMER 2,928,542

DRY PROCESS BENEFICIATION APPARATUS

Filed Oct. 4, 1957 2 Sheets-Sheet 1

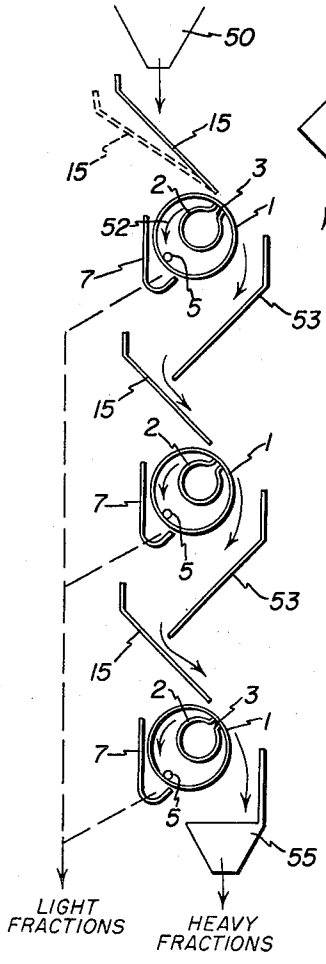


Fig.-1

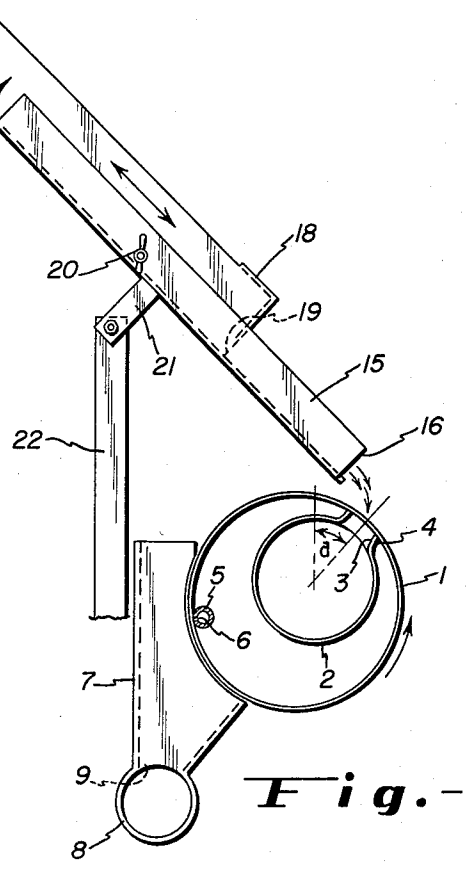


Fig.-2

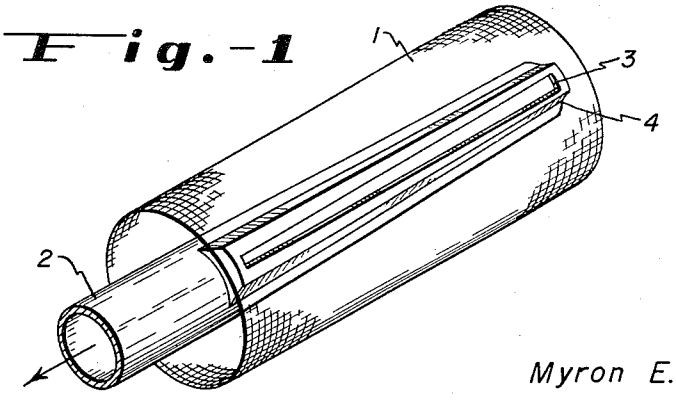


Fig.-3

INVENTOR.
Myron E. Mencimer
BY
McGrew and Edwards
ATTORNEYS

Published by AsbestosClaims.Law
asbestosclaims.law/library/22212/1

March 15, 1960 M. E. MENCIMER 2,928,542

DRY PROCESS BENEFICIATION APPARATUS

Filed Oct. 4, 1957 2 Sheets-Sheet 2

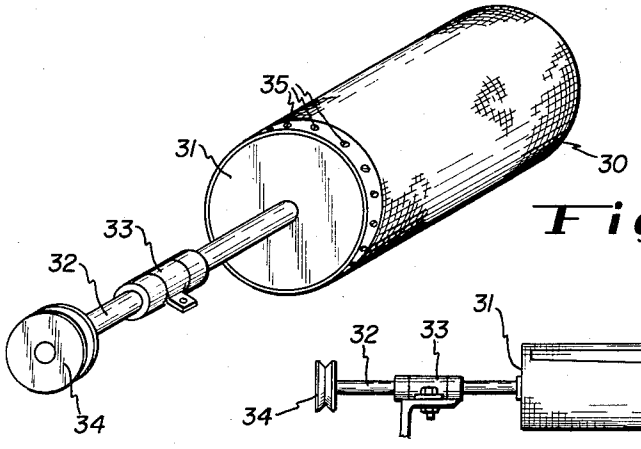


Fig.-4

Fig.-5

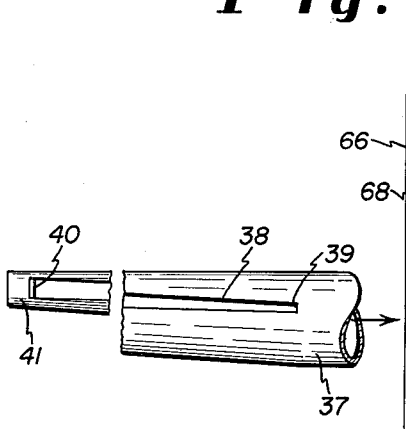


Fig.-6

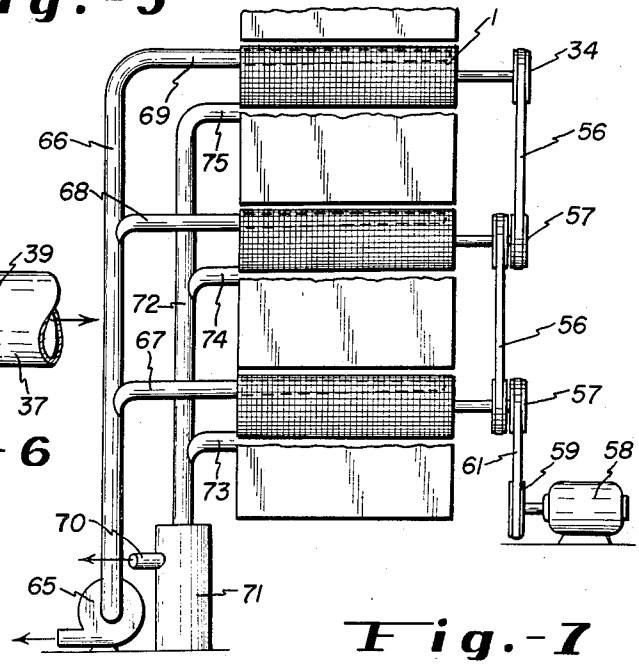


Fig.-7

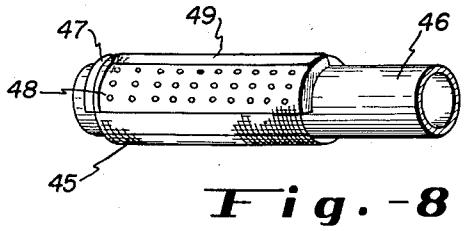


Fig.-8

INVENTOR.
Myron E. Mencimer
BY
Edward
ATTORNEYS

Published by AsbestosClaims.Law
asbestosclaims.law/library/22212/2

United States Patent Office 2,928,542
Patented Mar. 15, 1960

2,928,542

DRY PROCESS BENEFICIATION APPARATUS

Myron E. Mencimer, Denver Colo.

Application October 4, 1957, Serial No. 688,813

10 Claims. (Cl. 209—45)

This invention relates to dry process ore separators, and more particularly to pneumatic beneficiation apparatus for separating mineral values from their natural ores in a dry state, especially the beneficiation of such light mineral values as mica, asbestos, etc.

The apparatus of the present invention provides apparatus for the economical and efficient dry beneficiation of the natural ores which have been sufficiently ground or crushed to provide a separation of mineral values from accompanying gangue. The invention, also, provides an effective method for the dry beneficiation of natural ores. The method generally includes passing the finely divided ore onto a downwardly sloped foraminous member which is traveling in an upward direction. Suction is applied to the underneath side of the foraminous surface and the lighter components of the ore are retained on the surface and carried beyond the suction for discharge from the surface, while the heavier components fall downwardly along the surface and thus separate from light fractions. In a simple, effective embodiment of the invention a horizontally disposed cylindrical member having a foraminous surface is rotated in a direction to provide a downwardly sloped, upwardly moving surface adjacent the apex of the surface. Suction is applied to a portion of the cylinder below the crown or apex of the cylinder at about the point of introduction of the crushed ore onto the surface of the cylinder. Generally the ore is directed onto the surface from a feed chute launder providing short gravitational fall, and the direction of fall of the ore is preferably opposed to the direction of movement of the foraminous surface of the cylinder.

To provide an efficient and effective device a series of such cylinders may be used in a stepwise arrangement. Such a series of cylinders may be vertically spaced so that a gravitational flow of ore from cylinder to cylinder may be used. Such an arrangement provides an effective multiple step beneficiation process, in which the first step removes a substantial quantity of the lighter components of the ore and subsequent cylinders remove substantially all of the remaining amount of light components from the heavier components of the ore.

It is, therefore, among the objects and the advantages of the invention to provide apparatus for the dry beneficiation of the mineral values from their natural ores, which apparatus includes a pneumatic system arranged to provide dry separation of light components of the crushed ore from its heavier components. The apparatus provides a downwardly sloped, upwardly moving foraminous surface against which a stream of finely divided ores is directed, and a suction beneath at least part of the surface holds light components of the ore onto the surface for a sufficient period of time to permit separation of the light components from the heavier components. A foraminous, horizontal cylinder is provided with suction applied to the underside of the cylinder at one point for separating and holding light components from the heavier components of an ore, and the light components may be subsequently removed by an airblast

blown through the surface. A plurality of vertically disposed cylinders may be so interconnected as to provide an efficient multiple stage dry beneficiation apparatus.

These and other objects of the invention may be readily ascertained by referring to the following description and appended illustrations in which:

Figure 1 is a schematic flow sheet of a multiple stage separator according to the invention;

Figure 2 is an enlarged side elevational view of a single stage separator;

Figure 3 is an enlarged perspective view of one form of a suction system of the dry separator according to the invention;

Figure 4 is a perspective view of one form of foraminous cylinder, illustrating means for supporting and rotating the same;

Figure 5 is a side elevational view of the device of Figure 4;

Figure 6 is a detailed view of a suction tube for use in a foraminous cylinder according to the invention;

Figure 7 is a front elevation of a three stage separator, in partial broken away view, illustrating a general equipment set up; and

Figure 8 is a detailed perspective of a modified cylinder and suction system.

The enlarged detail illustrated in Figure 2 shows a single stage separator, and since each of the stages of a multiple stage machine will be constructed in substantially the same manner, description of the single stage will be sufficient for all the stages of such machine. A cylindrical screen member **1**, which is arranged substantially horizontal and mounted for rotary movement in the direction indicated, encloses a suction tube **2** which is substantially non-rotatable, except that it may be mounted so as to be rotated through a small arc for adjustment purposes. The suction tube has a slot **3** extending substantially along a major portion thereof, and the slot **3** has upstanding sidewalls **4**. The screen **1** is closely adjacent the upstanding wall **4** so that when suction is applied on the tube **2** air will be drawn from the outside through the screen and through the slot rather than from around the walls and the space inside the screen tube **1**. Suction when used in this application refers to a pressure differential created by lowering the air pressure in the tube **2**, as by interconnecting the tube with the intake or suction side of an air pump. An elongated tube or pipe **5** extends along the length of the screen and is supplied by a supply of air under superatmospheric pressure, and the pipe **5** contains a series of holes **6**, or a narrow slot, mounted adjacent to screen **1** in position to blow off any material adhering to the screen. A discharge chute **7** is mounted adjacent the air tube **5** with sufficient back and side walls to catch material falling from or blown from the screen. The material discharged from the screen into the discharge **7** falls into a collector tube **8** which has a slot **9** interconnecting the tube with the discharge **7**. By having one end of the tube **8** closed suction can be applied to the other end, and the light material collected from the screen may be withdrawn from the tube **8**, illustrated in Figure 7, described below.

A feed launder or chute **15** is adjustably disposed above the screen **1**, and its discharge end **16** is spaced so that ground ore discharging from the chute **15** falls on the screen **1** above the slot **3**. A baffle box **18** is disposed in the chute **15** and is adjustable along the length of the chute to provide an opening **19** for controlling the rate flow of ore from the sheet. A thumbscrew **20** provides means for holding the baffle box **18** in position in the chute. The chute **15** has a supporting arm **21** mounted on an upright member **22** of a frame (not shown) to provide an adjustable support for the chute. The chute **15** is adjustable both toward and away from the screen

Published by AsbestosClaims.Law
asbestosclaims.law/library/22212/3

1 and vertically so as to vary the distance between the discharge end 16 and the screen 1. Also, the slope of the feed chute 16 is adjustable through an angle so as to adjust the speed of travel of the ore. The suction tube 2 is rotatable through a small arc so as to adjust the angle "*a*," which is the angle between a center line of the slot and a vertical through the center or axis of the tube.

For small sizes, a tubular screen, illustrated in Fig. 4, may be merely a tubular screen 30 mounted on an end plate 31 to which a shaft 32 is attached. A bearing mount 33 encompasses a portion of the shaft 32 and is arranged to be mounted on a framework in position to hold the screen substantially horizontal. A pulley or sheave 34 provides means for rotating the screen journalled in the bearing housing 33. The screen of the tube should be substantial and heavy enough to support its own weight or supported on a frame, and under normal conditions the screen may vary from 16 to 200 mesh, depending upon the particular ore being used. The screen may be attached to the end plate 31 by means of screws 35, or any convenient means of mounting the screen securely on the end plate.

Where a longer cylindrical screen is desired, illustrated in Figure 5, a screen tube 36 is secured in a similar manner to the end plate 31, but the opposite end of the screen rests on a roller bearing support which includes a pair of rollers 78 on which the screen rests, and as the screen turns the rollers 78 rotatably support the inner end of the screen.

Where a long screen is used, a suction tube 37 is provided with a tapered slot 38, Figure 6, so as to provide a fairly even distribution of suction over the length of the screen. In this instance the tapered slot 38 has its narrow portion 39 adjacent the connection to the main suction line, while the wider end of the slot 40 is at the narrow end 41 of the suction tube 37. Normally the suction tube 37 is mounted on adjustable bracket 42 which is secured to a frame part 43. The adjustable bracket is arranged to permit a rotation of the tube through a small arc to permit adjustment of the position of the slot in relation to discharge end of the feed chute.

A modified screen and suction tube assembly is illustrated in Figure 8, which is generally useful for short screen sections. In this case a screen 45 is rotatably mounted on a suction tube 46, substantially as described above. The suction tube 46 includes a wide slot 47 which has a foraminous bottom 48 and side walls 49 surrounding the slot in position to be adjacent to the screen. The wide slot with the foraminous bottom provides means for extending the area of suction over the surface of the screen, which is useful for very light components.

The operation of the device may be illustrated by reference to the schematic drawing of Figure 1 wherein a feed bin 50 is arranged to introduce ore into the feed chute 15. The feed chute 15 is arranged to be moved to an angle found desirable for the particular ore being used. The chute 15 is positioned so that the ore issuing therefrom falls on the screen directly above the slot 3 in the upper suction tube. The screen is rotated as indicated by the arrow 52 and when suction is applied to the tube 2 the light fraction of the ore is held on the screen by the suction while the heavier components fall over the screen down onto an intermediate chute 53 which discharges onto a feed chute 15 for the second stage of the device. The light fractions pass over the crown or apex of the screen of the first stage and fall into collector 7. The light fractions which do not fall off the screen are blown off by means of the air tube 5. The ore passing along the intermediate chute 53 into the feed chute 15 of the second stage is subjected to suction of the second stage, the light fraction being collected in the chute collector 7 of the second stage while the remainder of the ore passes on through the second intermediate chute 53 onto the feed chute 15 of the third stage. The heavy fractions from the third stage pass into a heavy fractions collector 55 which is discarded or utilized as the case may be. The air flow of the collector system is illustrated in Figure 7, where a series of three screens 1 are mounted in vertical position. The upper screen 1 is rotated by means of a V-belt drive 56 interconnected between a double sheave 57 mounted on the second stage to V-belt sheave 34 of the first stage. The second stage is driven by means of a V-belt 56 interconnected between the double V-belt sheave 57 of the third stage and the double V-belt sheave 57 of the second stage. A motor 58 having a V-belt sheave 59 mounted on its shaft is interconnected by means of a V-belt 61 to the double pulley 57 of the third stage providing motivating power for rotating all of the screens. An air pump 65, which may be any type of pump available to provide the capacity needed for the operation of the device, is interconnected to a header 66 which has feeds 67, 68 and 69 interconnected with the suction tubes in each of the screen tubes 1 mounted on the device.

The light fractions are collected from the collector tube 8 by means of a suction pump, not shown, interconnected with an outlet 70 on a collector and separator drum 71 which acts as a separator from the air and the light fractions. A header 72 connected to the drum has a plurality of leads 73, 74 and 75 interconnected with the collector tube of each stage.

In typical operation on a mica ore having a mica content of between 20 and 60%, the ore is ground to about 20 mesh size, which means that substantially all the ground ore passes a 20 mesh screen. Each of the screens 1 is a 40 mesh screen tube mounted in position for rotation over a suction tube 2. The pump 5 has sufficient capacity to provide a few pounds differential air pressure between the outside and the inside of the screen so that light material may be held on the screen. The mica is fed into the first stage from the hopper 50 and the first stage collects mica in the collector 7. The first stage collects the major portion of the mica from the ore, and the two cleanup stages that follow pick up substantially the rest. The concentrate obtained from the collector tubes 8 contains in excess of about 99% mica while the tails discharged into the hopper 55 contain less than 2% mica. The screens are rotated at about 75 revolutions per minute, with the slot 3 mounted at about 30° from the crown of the screen. The discharge 16 is positioned within one and a half inches from the screen surface above the slot.

By adjusting the angle "*a*" of the slot and the angle of the feed chute, and, also, the distance of discharge 16 above the slot, various types of ore may be beneficiated. For example, asbestos may be separated from its rock or gangue by crushing the asbestos ore and recovering the asbestos in the collector tube 8 while the gangue is discarded. Uranium ore, for example carnotite, may, also, be separated by means of the device where the crushed ore is passed over the screens. In this case the heavier uranium values are collected in the heavy fractions hopper 55, while the lighter fractions or gangue are discarded. Any of the ores in which a crust is formed on the rock gangue and in which the mineral values may be scrubbed off by milling may be beneficiated by the device. Also, where a classification of the recovered values is desired, different coarseness of screen may be used on the different stages to effectively provide a classification.

While the device has been illustrated by reference to specific embodiments, there is no intention to limit the intent or the spirit of the invention to the precise details so set forth.

I claim:

1. Apparatus for the dry beneficiation of mineral values from their natural ores comprising at least one horizontally disposed hollow member, a foraminous cylinder covering said member and mounted for independent rotation thereon, a slot in said member extending a substantial

Published by AsbestosClaims.Law
asbestosclaims.law/library/22212/4

distance therealong and mounted adjacent to and below the crown of said foraminous cylinder, means for applying suction on said slot so as to draw air only through said foraminous cover over said slot, feed chute means arranged for passing a thin spray of ore in a gravity flow onto the foraminous cylinder above said slot, means for rotating said foraminous cylinder in the direction from said slot upwardly toward the crown thereof, and means arranged to collect light ore fractions carried over the crown of said cylinder.

2. Apparatus for the dry beneficiation of mineral values from their natural ores comprising at least one elongated horizontally disposed hollow member, a foraminous cylinder of larger cross sectional dimensions than said member covering said member and mounted for independent rotation thereon, a slot in said member extending a substantial distance therealong and adjustably mounted adjacent to and below the crown of said foraminous cylinder, means for applying suction on said member so as to draw air only through said foraminous cover over said slot, feed chute means arranged for passing a thin spray of ore in a gravity flow onto said foraminous surface covering said slot, means for rotating said foraminous cylinder in the direction from said slot upwardly toward the crown thereof, and means opposite said slot arranged to blow air through said foraminous surface to remove adhering ore components.

3. Apparatus for the dry beneficiation of mineral values from their natural ores comprising at least one horizontally disposed hollow cylinder, a foraminous screen cylinder covering said hollow cylinder and mounted for independent rotation thereon, said screen having a substantially larger diameter than said hollow cylinder, a slot in said cylinder extending a substantial distance therealong and mounted adjacent to the inner surface of and below the crown of said foraminous member and in an upper quadrant thereof, means for applying suction to said hollow cylinder so as to draw air only through said foraminous screen covering said slot, feed chute means arranged for passing a thin spray of ore on said foraminous cylinder in position so that the dropping ore falls on the foraminous surface above said slot, means for rotating said screen cylinder in the direction from said slot upwardly toward the crown thereof, and means arranged to blow air through a narrow elongated portion of said surface to remove adhering ore components carried over the crown of the foraminous cylinder.

4. Apparatus for the dry beneficiation of mineral values from natural ores comprising a horizontally disposed screen cylindrical member mounted for rotation, a tube mounted in said screen member and arranged with a slot juxtaposed to the inner surface of said screen, said slot being disposed adjacent to and below the crown of said screen member, said tube being substantially smaller in diameter than the diameter of said screen member, means for applying suction to said tube so as to draw air through said slot and the portion of said screen member above said slot, means for dropping a gravity flow of a thin spray of ore onto said screen member above the slot in said tube, means for rotating said screen member in a direction from said slot upwardly toward the crown of said screen, and means for recovering light fractions of ore adhering to said screen member passing over the crown thereof.

5. Apparatus for the dry beneficiation of mineral values from natural ores comprising a horizontally disposed screen cylindrical member mounted for rotation, a tube mounted in said screen member and arranged with an elongated tapered slot juxtaposed with the inner surface of said screen and disposed adjacent to and below the crown thereof, said tube being substantially smaller in diameter than the diameter of said screen member, means for applying suction to said tube so as to draw air through said slot and the portion of said screen member above said slot, means for dropping a gravity flow of a thin spray of ore onto said screen member above the slot in said tube, means for rotating said screen member in a direction from said slot upwardly to the crown of said screen, and means for recovering light fractions of ore adhering to said screen member passing over the crown thereof.

6. Apparatus for the dry beneficiation of mineral values from natural ores comprising a horizontally disposed screen cylindrical member mounted for rotation, a tube mounted in said screen member and arranged with a wide, walled slot juxtaposed with the inner surface of said screen disposed adjacent to and below the crown thereof, said tube being substantially smaller in diameter than the diameter of said screen member, means for applying suction to said tube so as to draw air through said slot and the portion of said screen member above said slot, means for dropping a gravity flow of a thin spray of ore on said screen member above the slot in said tube, means for rotating said screen member in a direction from said slot upwardly to the crown of said screen, and means for recovering light fractions of ore adhering to said screen member passing over the crown thereof.

7. In apparatus for the dry beneficiation of mineral values from their natural ores in which a foraminous member is rotated over a hollow member with a slot closely juxtaposed to the inner surface of said foraminous member and arranged for drawing air through said foraminous member, the improvement which comprises a hollow member having a tapered slot therein with a narrow portion of the tapered slot adjacent the connection to the source of suction, and upstanding walls extending outwardly from said hollow member forming the peripheral boundary of said slot and arranged with the opening positioned closely adjacent the inner surface of said foraminous member.

8. In apparatus for the dry beneficiation of mineral values from their natural ores in which a foraminous member is rotated over a tube with a slot closely juxtaposed to the inner surface of said foraminous member and arranged for drawing air through said foraminous member, the improvement which comprises said tube having an elongated tapered slot arranged so as to permit air to be drawn through a portion of the foraminous member, upstanding walls extending outwardly from said tube forming the peripheral boundary of said slot and arranged to be positioned closely adjacent the inner surface of said foraminous member, and a foraminous bottom on said slot forming communication with said tube.

9. Apparatus for the dry beneficiation of mineral values from their natural ores comprising a horizontally disposed, hollow foraminous cylinder arranged for rotation, a suction tube of substantially smaller cross sectional dimensions than said foraminous cylinder disposed therein and having means for its connection to an air pump for reducing air pressure therein and draw air through a portion of said foraminous cylinder, there being a slot having upstanding walls bordering the same in said tube mounted closely adjacent to and extending substantially along the length of said foraminous cylinder, means for adjusting the angular position of said slot in relation to said foraminous cylinder, feed launder means adjustably arranged to drop a thin spray of finely divided ore in a gravity flow onto the outer surface of said foraminous cylinder above said slot, means for rotating said foraminous cylinder in a direction from said slot upwardly toward the crown of said cylinder, discharge means arranged adjacent the foraminous cylinder at a position opposite said slot and mounted for collecting light fractions of ore carried over the crown of said foraminous cylinder, and means for removing adhering light fractions on said foraminous cylinder.

10. Apparatus for the dry beneficiation of mineral values from their natural ores comprising at least one horizontally disposed hollow member, an endless, movable foraminous member covering a portion of said hollow

Published by AsbestosClaims.Law
asbestosclaims.law/library/22212/5

member with a portion thereof disposed on a slope below a high point, said foraminous member being arranged for upward movement across said portion, a slot in said hollow member extending a substantial distance therealong and mounted adjacent to the sloped portion of said foraminous member and below a high point thereof, means for applying suction on said hollow member so as to draw air only through the sloped portion of said foraminous cover over said slot, feed chute means arranged for passing a thin spray of ore in a gravity flow on said foraminous surface in position so that the dropping ore falls on the foraminous surface above and flows downwardly over said slot, means for moving said foraminous surface in the direction upwardly from said slot toward the high point on said surface, and means on the opposite side of said high point arranged to collect light ore components held on said surface.

References Cited in the file of this patent

UNITED STATES PATENTS

1,392,094	Toler	Sept. 27, 1921
1,408,688	Broadmeyer	Mar. 7, 1922
1,913,876	Frederick	June 13, 1933
2,134,216	Sutter	Oct. 25, 1938
2,138,529	Thys	Nov. 29, 1938
2,236,363	Backhouse	Mar. 25, 1941
2,614,691	Slayter	Oct. 21, 1952

FOREIGN PATENTS

233,597	Great Britain	May 14, 1925
58,453	Norway	Oct. 4, 1937