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A. E. LAGARDE
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INTO A PLURALITY OF SIZE GRADES

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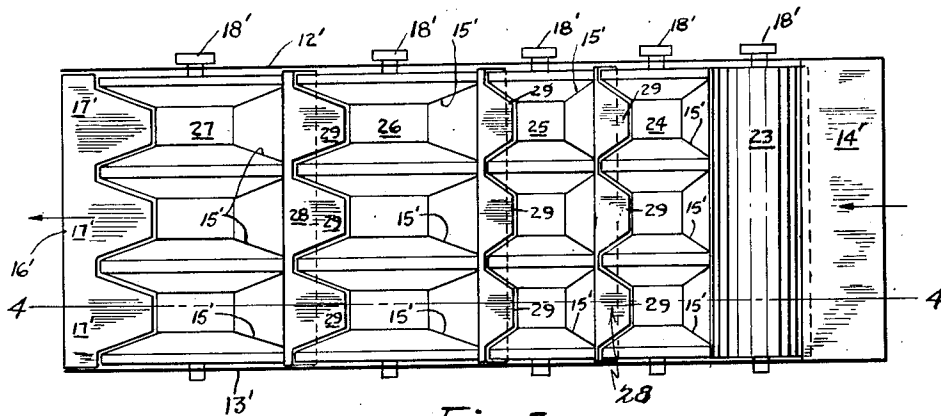


Fig. 3

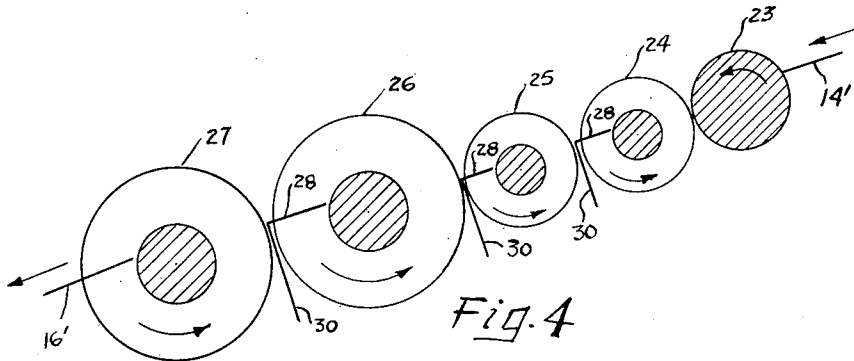


Fig. 4

INVENTOR.
AUGUSTE E. LAGARDE
BY *Adams + Bush*
ATTORNEY

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2,786,573

DEVICE FOR SEPARATING SOLID PRODUCTS INTO A PLURALITY OF SIZE GRADES

Auguste Edmond Lagarde, Viroflay, France, assignor to Societe Preparation Industrielle des Combustibles, Avon, France, a French company

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9 Claims. (Cl. 209—104)

This invention relates to the separation of solid products according to size and has more particular reference to screening apparatus for separating solid products such as coal, ore and the like into a plurality of size grades.

Large mesh screening of solid products is usually effected on screening devices comprising a plurality of rollers which are rotated in the same direction and are provided with grooves which form the screening openings. Upon these devices a solid product lump arriving on the right of a screening opening is normally submitted to three stresses, i. e., the weight of the lump itself and of those pressing it tending to make the lump pass through the opening, called "weighing stress"; a stress taking place in the same direction as the weight, due to the tangential rubbing of the roller ahead in relation to the opening, called "clogging stress"; a stress happening in the opposite direction to that of the weight, caused by the tangential rubbing of the roller behind in relation to the opening called "unclogging stress."

When lumps are smaller than the mesh they pass through it without difficulty. However, when a lump of a size slightly larger than a screening opening engages in an opening, the clogging stress acting in the same direction as the weighing stress and added to the latter may become preponderant when compared to the reverse unclogging stress, resulting in the lump becoming jammed between the rollers.

One object of the present invention is to provide novel and improved apparatus of the type employing grooved rollers to form screening openings for separating solid products such as coal, ore and the like into a plurality of size grades so constructed as to automatically remove from the screening openings any product lump that tends to jam therein.

Another object of the present invention is to provide novel and improved apparatus, as characterized above, wherein the forward edge of each screening opening is a substantially smooth straight edge in order to eliminate or reduce the rubbing stress tending to cause an oversized lump to clog the opening.

Another object of the present invention is to provide apparatus, as characterized above, wherein the side walls of the opening may be formed by fixed members having smooth substantially straight edge portions or by a cylindrical roller.

A further object of the invention is to provide apparatus, as characterized above, wherein the side walls of the grooves forming the screening openings may be roughened and/or made of flexible material.

Other objects and advantages of the invention will appear in the specification, when considered with the following drawings, wherein:

Fig. 1 is a diagrammatic plan view of a screening apparatus constructed in accordance with the present invention;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1;

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Fig. 3 is a diagrammatic side elevational view of a modified form of apparatus;

Fig. 4 is a section taken on the line 4—4 of Fig. 3; and

Fig. 5 is a fragmentary plan view, with parts broken away, showing the details of a modified form of grooved roller.

Referring now to the drawings, there is diagrammatically illustrated in Figs. 1 and 2, one embodiment of apparatus constructed in accordance with the present invention. As there shown, the apparatus comprises a cylindrical roller 10 and a grooved roller 11 suitably journaled in side frame members 12, 13 of the apparatus for rotation about horizontal axes. The frame members 12, 13 are inclined so that the axis of the cylindrical roller 10 is positioned above that of the grooved roller 11. The products to be screened are fed onto the screening bed as by means of a chute 14 formed by an inclined plate extending across the top of the machine. The inner end of the chute 14 terminates close to the outer side of the cylindrical roller 10 and below the top thereof, thus facilitating the shoring and good distribution of the products on the whole width of the screen bed or grate by the roller 10. The sides of the groove and the after straight tangential edge of the roller 10 define the screening openings 15 of the grate. A comb-like member 16 in the form of a flat plate having laterally spaced teeth 17 along one edge extending into the grooves of the roller 11, extends between the side frame members of the apparatus at the discharge end. The plate 16 extends downwardly at an angle to the horizontal radius of the roller 11 and the products which are too large to pass through the openings 15 pass over the plate 16 and out of the machine. The bottom of the machine is open and a suitable chute or hopper to receive the products which pass through the screening openings 15 may be provided.

Any suitable means may be provided to rotate the rollers 10 and 11 counterclockwise as viewed in Fig. 2, such as a pulley or sprocket 18 mounted on one end of the journal of each of the rollers and adapted to be driven by any suitable means.

The operation of the device is as follows: The products to be screened are fed onto the screen bed by means of the feed chute 14. The roller 10 slows down the feed of the products and insures a regular feeding. The products travel over the roller 10 and those small enough fall through the screen openings 15; those too large to pass through the openings 15 travel over the roller 11 onto the plate member 16 and are discharged from the apparatus.

Certain of the products may be too large to pass through a screening opening 15 yet of a size to tend to clog the opening. The construction and operation of the machine is designed to automatically free such products so that they can pass over the roller 11 and from the machine.

For example, as shown in Fig. 1, an oversized lump L, too large to pass through the screening opening 15, is engaged by the lateral faces of the groove where it jams. The forces or stresses acting on the lump, indicated by arrows in Figs. 1 and 2, are as follows: the weight stress indicated by arrow 19, in Fig. 2, support stresses indicated by arrows 20, 20a in Fig. 1, caused by the pressure of the side walls of the opening against the lump, these stresses being stronger since they are equal to the weight stress plus the dynamic stress caused by the fall of the lump into the opening, a tangential stress, indicated by arrow 21 in Fig. 2, produced by the roller 10 tending to press the lump into the groove, and creating a resulting upward tangential stress, indicated by the arrow 22 in Fig. 2, produced by the unclogging rubbing action of the roller 11. The result of this stressing system frees the lump L.

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from the screening opening and the lump is pressed and driven between the sides of the grooves in the roller 11 and as it passes over the roller is liberated by the tooth of the comb-like member 16 engaging in the groove.

In Figs. 3 and 4 there is shown a modified form of apparatus. In this modification, a plurality of rollers, five such being shown, 23, 24, 25, 26 and 27, are mounted between the inclined side frame members 12', 13' of the machine for rotation about horizontal axes, with the axis of rotation of each roller being laterally spaced from and vertically spaced below the axis of rotation of the preceding roller. The product to be treated is fed into the screening bed through chute 14' and the largest products pass from the machine over a comb-like plate 16', as in the modification shown in Figs. 1 and 2.

The uppermost roller 23 is a cylindrical roller and the adjacent lower roller 24 is a grooved roller. These two rollers are identical in construction to the corresponding rollers 10 and 11 of the modification shown in Figs. 1 and 2 and are mounted at the inlet end of the machine in the same manner to form screening openings 15', as are rollers 10 and 11 of the modification shown in Figs. 1 and 2.

Grooved rollers 25, 26 and 27 are identical in construction to grooved roller 24. However, rollers 26 and 27 are of a larger diameter than roller 25, whereas roller 25 is of the same diameter as roller 24. This provides a plurality of different meshes in the same machine as the openings 15' between the various pairs of rollers will be of different size. Suitable means, such as pulleys or sprockets 18' are mounted on one end journal of each of the rollers. The sprockets 18' are adapted to be driven by any suitable means for rotating the rollers in a clockwise direction as viewed in Fig. 4.

A plurality of comb-like members 28 extend across the machine with their ends fixedly secured to the sides of the machine, one positioned between the pair of rollers 24, 25; 25, 26; and 26, 27. The comb-like members 28 are identical in construction and, as shown, each comprises a flat plate having a plurality of comb-like teeth 29 extending laterally and forwardly from its upper edge and a downwardly and forwardly extending flange 30 formed along its lower edge. The teeth 29 of each comb-like member are positioned to interfit into the grooves of the adjacent forward roller and smoothly liberate any jammed lumps carried in the grooves. The teeth extend in a plane inclined downwardly in relation to the horizontal radius of the adjacent forward roller.

The foregoing construction permits the portions of the members 28 which form the forward edge of the openings 15' to function in the same manner as roller 10 in the apparatus shown in Figs. 1 and 2, in resolving the stress system acting on a jammed lump to force it into the grooves in the following grooved roller so it will travel through the machine, either to fall through the next larger opening or to pass completely through the machine.

The grooved surface of the grooved rollers of either modification may be smooth or roughened in order to increase the unclogging stress. Also, the side walls of the grooves may be provided with a coating 31 of flexible material, such as synthetic rubber or the like, as shown in Fig. 5, to avoid any danger of crushing the products. Also, preferably and as shown in both modifications, the side walls of the grooves of all of the grooved rollers are outwardly and oppositely inclined.

From the foregoing, it readily will be seen that there has been provided novel and improved apparatus for separating solid products such as coal, ore and the like, into a plurality of size grades; apparatus employing grooved rollers to form the side edges of the screening openings and provided with screening elements having smooth substantially straight portions forming the front edge of the screening openings so that the forces tending to cause an oversized lump to jam in an opening will

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be less than the forces tending to unclog the jammed oversized lump, whereby the lump will be unclogged.

Obviously the invention is not restricted to the particular embodiment thereof herein shown and described.

What is claimed is:

1. Apparatus for separating solid products such as coal or the like into a plurality of size grades comprising a pair of cooperating screening elements spaced apart in parallel relationship to form screening openings, one of said elements being constituted by a roller provided with a plurality of axially spaced circumferential grooves each having outwardly and oppositely inclined side walls, the other of said elements over which the products being screened travel first having an elongated smooth straight side portion positioned above the axis of said roller and forming with said grooves said screening openings; means for delivering the products to be screened so that they will travel across in succession the screening element having the straight side portion and the grooved roller, whereby products sufficiently small in size will fall through said screening openings; and means for rotating said roller in a direction to cause the products which do not fall through said screening openings to pass over said roller, the construction and arrangement being such that when an oversized product tends to jam in a screening opening, the unclogging rubbing stress created by the upward rotation of the side walls of the groove forming part of the opening will be greater than the weight stress of the jammed product plus the rubbing stress of the smooth straight edge portion of the opening formed by the smooth side portion of said other of said screening elements, whereby the jammed product will be unclogged.

2. Apparatus as set forth in claim 1, wherein said other of said screening elements is a fixed member.

3. Apparatus as set forth in claim 1, wherein said other of said screening elements is a cylindrical member having its axis of rotation at a higher elevation than the axis of rotation of said roller and wherein means are provided for rotating said cylindrical member in the same direction as the direction of rotation of said roller.

4. Apparatus as set forth in claim 1, wherein the surfaces of the grooves are rough surfaces.

5. Apparatus as set forth in claim 1, including an elongated downwardly inclined comb-like plate mounted adjacent the discharge side of said grooved roller, said plate having a plurality of laterally spaced teeth formed on the edge adjacent said roller with said teeth being interfitted into the grooves on said roller to close said grooves.

6. In apparatus for separating solid products such as coal or the like into a plurality of size grades, an inclined frame, a plurality of rollers journaled on said frame, said roller having axially spaced circumferential grooves thereon, a plurality of fixed comb-like plates having spaced teeth formed along one edge and having a smooth substantially straight surface along the other edge extending transversely of said frame, one positioned between each adjacent pair of grooved rollers with its teeth extending forwardly and upwardly with each tooth interfitted into a corresponding groove of the forward grooved roller of the pair and with its smooth straight edge portion defining with the sides of the groove in the after grooved roller of the pair a plurality of screening openings each having a substantially straight smooth forward edge; an elongated member mounted on said frame and positioned forwardly of and parallel with the uppermost of said grooved rollers and having a substantially straight smooth edge portion forming with the grooves in said uppermost roller a plurality of screening openings; means for delivering the products to be screened so that they will travel across, in succession, said elongated member and said grooved rollers, whereby products of sufficient small size will fall through said screening openings; and means for rotating all of said rollers in a direction to cause products not falling through the screening open-

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ings to pass over the rollers, the construction and arrangement being such that when an over sized product tends to jam in a screening opening, the unclogging rubbing stress created by the upward rotation of the side walls of the groove forming part of the opening will be greater than the weight stress of the jammed product plus the rubbing stress of the smooth straight forward edge of the opening, whereby the product will become unclogged.

7. Apparatus as set forth in claim 6, wherein the 10 grooves on successive rollers are of different size to provide screen openings of different size.

8. Apparatus as set forth in claim 6, wherein each of

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said comb-like members is provided with a downwardly and forwardly extending flange along its after edge to facilitate the liberation of jammed products.

9. Apparatus as set forth in claim 6, wherein the 5 grooves on the grooved rollers are provided with roughened surfaces.

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