Nov. 10, 1953 R. G. FERNALD 2,658,603

APPARATUS FOR HANDLING GRANULAR MATERIAL

Filed Jan. 28, 1950

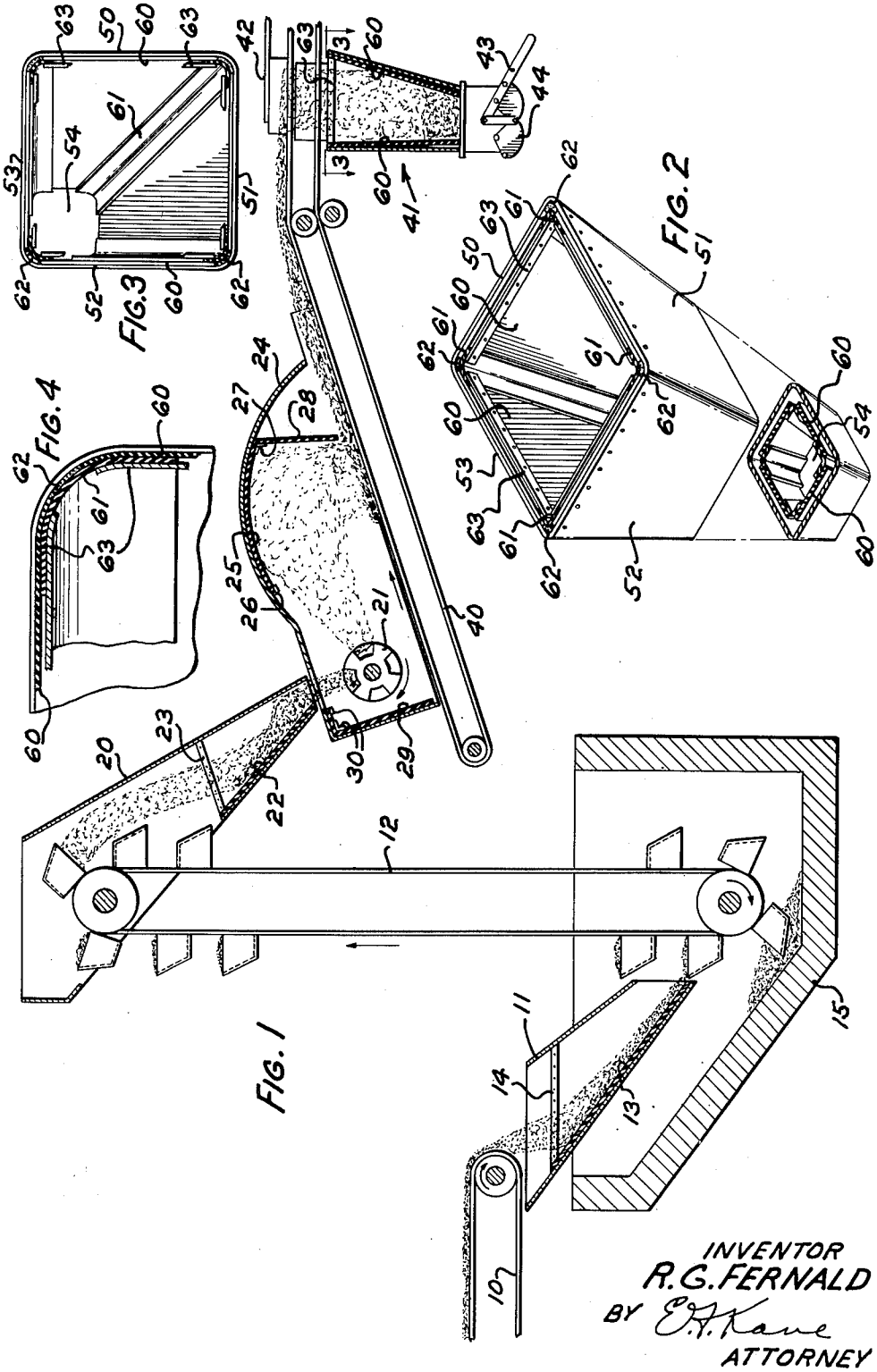

FIG. 1

FIG. 2

FIG. 3

FIG. 4

INVENTOR
R. G. FERNALD
BY E. F. Kane
ATTORNEY

Patented Nov. 10, 1953

2,658,603

UNITED STATES PATENT OFFICE

2,658,603

APPARATUS FOR HANDLING GRANULAR MATERIAL

Russell G. Fernald, Downers Grove, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application January 28, 1950, Serial No. 141,145

9 Claims. (Cl. 198—57)

1

This invention relates to methods of and apparatus for handling granular materials and more particularly to a method of and apparatus for constructing the inner surfaces of granular material receiving or handling equipment.

In the handling and transfer of many granular materials, it is necessary or desirable that the materials be in a more or less moist condition, either for reasons necessitated by their ultimate use or for handling reasons. In foundries, for example, molding sand which is to be used to form a mold must be slightly damp in order that proper adherence be maintained in the mold, and in mechanized foundries where molding sand is automatically conveyed to hoppers or other receiving bins at molding stations, such sand is conveyed between and transferred from the various components of the foundry system while in a relatively moist condition. In the past, all of the transfer bins, hoppers, aerators and most other equipment with which the sand comes in contact have been of metallic construction and, as a consequence thereof, an appreciable amount of sand has a tendency to adhere to such metallic surfaces. Such adherence of the sand to the metallic surfaces results in many undesirable effects tending to reduce the efficiency of the equipment. In the first place, the equipment tends to become clogged and consequently the volume of sand transferred decreases. In the second place, sand adhering to the sides of the equipment tends to dry out and then fall back into and mix with the properly moistened sand. The latter action results in molds of poor texture and frequently results in poor castings. Numerous other disadvantages resulting from sand or other granular materials adhering to such surfaces are apparent; however, it is believed that, with respect to sand molding, the two mentioned above are the most important.

It is an object of this invention to facilitate the handling of sand or the like granular materials by eliminating the tendency of the granular material to adhere to surfaces with which it comes in contact.

In accordance with one embodiment of the invention, a method of and apparatus for eliminating adherence of granular materials to surfaces may comprise providing such surfaces with liners consisting of an elastic and compressible material such as freely flexible rubber or the like material. Ordinarily, in the case of a surface at an angle to the horizontal and over which granular material flows, such a liner may be secured to the surface at its top edge and freely

2

suspended so as to assume a normal position either in contact with or in close proximity to the surface to which the sand tends to adhere. Thus it will be seen that any sand or other granular material coming in contact with the rubber liner and adhering thereto will set up unbalancing forces in the flexible liner tending to distort it. The distortion, in turn, tends to cause the bond to be broken between the liner and the adhering material, thereby allowing the material to continue its progress. It has been found that such bonds are caused to be broken by two separate forces which are set up in the liner by adherence of material thereto. One of the forces is exerted due to the actual stretching of the liner and the other and more important force is exerted due to the actual compression or expansion of the liner due to the forces exerted substantially normal to the surface of the liner by the weight of the material adhering thereto. Whether the normal force is one of compression or expansion depends upon the orientation of the liner, as will be more fully explained hereinafter.

A more complete understanding of the invention may be had by referring to the following detailed description of one embodiment of the invention which is illustrated in the accompanying drawing wherein:

Fig. 1 is a schematic diagram of a part of the sand handling apparatus used in a foundry;

Fig. 2 is an isometric view of a molder's hopper;

Fig. 3 is a top plan view of the molder's hopper shown in Fig. 2; and

Fig. 4 is an enlarged view in cross section showing the details of construction of one of the four corners of the molder's hopper.

It is to be noted that although the invention has been illustrated and will be described with reference to the handling of molding sand in a foundry, the invention is capable of being used in conjunction with the handling of any other granular materials. For example, the invention may be used to advantage in conjunction with the handling of pulverized coal wherein it is necessary to moisten the coal in order to reduce the amount of dust resulting from its handling. The invention may also be employed in handling other granular materials such as sugar, salt, et cetera.

Referring to Fig. 1 of the drawing, a collecting belt conveyor 10 serves to transport moist molding sand from a muller (not shown) and the sand is then dumped into a chute 11, wherein it travels by gravity until it is deposited in a vertical

bucket conveyor 12. A bin 15 may also be provided to catch any of the sand flowing through the chute 11 that is not picked up by the buckets on the bucket conveyor 12. Since the sand being carried by the collecting belt conveyor 10 is in a relatively moist state, the sand gravitating over the lower side of the chute 11, as well as along the vertical sides thereof, has a tendency to adhere to the surfaces thus contacted by the sand. This condition is, of course, undesirable since it has a tendency to impede the free flow of moving sand through the chute 11. In order to obviate this condition, sheets 13 of rubber or the like material may be provided along the bottom and side walls of the chute 11 and these sheets 13 may be secured in overlapping relationship with the walls of the chute 11 by means of holding strips 14, which may be of any suitable material, such as hard rubber or metal.

After passing through the chute 11, the molding sand is transported upward by the bucket conveyor 12, where it is deposited in a chute 20 positioned with its exit above an aerator 21. The chute 20 may, likewise, be provided with sheets 22 of rubber or the like material overlapping those portions of the chute 20 with which the sand comes in contact. Suitable holding strips 23 may also be employed to secure the sheets 22 within the chute 20. Sand passing through the exit of the chute 20 and falling into the aerator 21 is finely dispersed as it is ejected from the aerator. The finely dispersed sand is impinged on various inner surfaces of a casing 24, which surrounds the aerator 21 and the impinging sand has a tendency to adhere to the inner surfaces of the casing 24 and thereby impede the free flow of sand in the system. To reduce the amount of sand thus adhering to the inner surfaces of the casing 24, various designs of rubber sheets may be employed. One portion of the inner surface of the aerator casing 24 has an arcuate configuration and since this portion is at the position where the majority of the aerated sand impinges, a sheet 25 of rubber or the like material may be provided along the inner arcuate surface. The sheet 25 is secured at both ends by holding strips 26 and 27. Thus it is obvious that the bond formed between the sheet 25 and any sand impinging thereon will be broken by virtue of the weight of the sand acting in a direction substantially normal to the surface of the sheet to cause a physical deformation thereof. The sheet 25 may also be provided with a loosely hanging extension 28, which also serves to prevent sand from sticking to the casing 24. It is obvious, of course, that in the case of the extension 28, the weight of the sand adhering thereto causes an actual stretching of the extension 28 in a direction longitudinal therewith. This stretching is also effective to rupture the bond existing between the sand and the extension 28. Another sheet 29 having holding strips 30 may also be provided within the aerator casing 24 and the function of the sheet 29 is the same as the function of sheets 13 and 22.

The aerated sand is picked up by a belt conveyor 40 on which it is transported to positions above a plurality of molder's hoppers 41, only one of which is shown. The sand is deflected from the conveyor 40 into the molder's hoppers by means of plows 42, and the sand may then be released from the hoppers 41 when needed by manual operation of a handle 43, which controls a gate 44.

The construction of the molder's hopper 41 is

shown in detail in Figs. 2, 3 and 4. As is evident from reference to Fig. 3, the molder's hopper 41 is so fabricated that it has two sloping sides 50 and 51 and two substantially vertical sides 52 and 53, and the four sides thereof converge to form a reduced exit 54. Since the gate 44 is only open when sand is desired by the operator, it will be apparent that sand will, at times, be stationary within the hopper 41. Since the sand is still in a moist condition, the fact that its movement is not continuous increases its tendency to adhere to the interior surfaces of the hopper 41. For this reason, sheets 60 of rubber or the like material are suspended in overlapping relation with each of the sides of the hopper 41. The sheets 60 are fabricated into a complete lining for the hopper by providing rubber corner strips 61, which are vulcanized to the vertical edges of the sheets 60. Since it is undesirable to allow any sand to accumulate behind the liner thus formed, suitable filler material 62 may be provided at each corner between the edges of the sheets 60 and between the corner strips 61 and the hopper 41. The filler material 62 need not extend the complete height of the hopper, but may extend only a few inches downward from the top of the hopper. The liner thus formed by the sheets 60, corner strips 61 and filler material 62 may then be secured to the molder's hopper by means of holding strips 63, which are preferably strips of a suitable metal of sufficient strength to support the weight of the liner.

It will be seen, therefore, that in all cases where granular materials have a tendency to adhere to surfaces over which they are flowing either by gravity or otherwise, such adherence may be prevented by providing liners of relatively soft pliable rubber or like material over the surfaces. It will be further seen that any material adhering to such rubber liners tends to distort the liner to such an extent that the bond between the liner and the adhering material is effectively broken. In the case of granular material adhering to a liner in such a manner that a component of the weight of the material is in a direction substantially normal to the plane of the liner, the actual compression or expansion of the liner caused by the normal component of weight of the material adhering thereto causes the bond to be broken. In addition to the component of weight normal to the plane of the liner, a second component of the weight of the material parallel to the plane of the liner also causes the liner to be stretched longitudinally to thereby further assist in the breaking of the bond between the material and the liner. In the case of a vertical liner, the weight of the material has no component perpendicular to the surface of the liner and the bond between the material and the liner is broken only by virtue of the longitudinal stretching of the liner.

Any relatively flexible, commercially available elastic and compressible material such as rubber or the like may be employed as liner material, and the thickness of the rubber liner may be varied according to the conditions encountered. For example, commercially available relatively soft pliable sheet rubber of a thickness of approximately ⅛ inch may be advantageously employed.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will em-

body the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. In equipment for handling moistened granular material having chutes into which the material is dumped for movement therethrough, flexible elastic and compressible liners suspended at their upper edges only within the chutes in overlapping relationship with the inner surfaces of said chutes, the weight of the material adhering to said liners being effective to stretch and distort said liners to maintain their surfaces clean of said material.

2. An apparatus for handling moistened granular material, which comprises a guiding element composed of inelastic material, a curtain composed of elastic compressible material disposed in a position covering the guiding element, exclusive means suspending the curtain in said position relative to the guiding element, said curtain-suspending means serving to permit at least the portion of the curtain from one end thereof to the central portion thereof hang free with respect to the guiding element, and means for advancing moistened granular material past the element and curtain.

3. An apparatus for handling moistened granular material, which comprises a conduit having an entrance end and an exit end through which moistened granular material may be advanced, a liner composed of elastic material extending generally along the conduit, and exclusive means securing an end portion of the liner in a position in which the unsecured portion of the liner extends toward the exit end of the conduit, whereby the portion of the liner beyond the securing means is free to stretch and compress to dislodge granular material stuck thereto.

4. An apparatus for handling moistened granular material, which comprises a conduit having an entrance end and an exit end through which moistened granular material may be advanced, a sheet composed of elastic material extending generally along the conduit, and exclusive mounting means securing against movement relative to the conduit only portions of the sheet spaced substantially from the end thereof nearer to the exit end of the conduit, whereby the portion of the sheet etxending beyond the mounting means toward the exit end of the conduit is free to stretch and compress to dislodge granular material stuck thereto.

5. An apparatus for handling moistened granular material, which comprises a hopper disposed vertically, a generally tubular liner designed to fit loosely into the hopper, said liner being composed of compressible elastic material, and exclusive liner-mounting means fastening only the upper portion of the liner against movement relative to the hopper and maintaining the lower portion of the liner free so that the liner may

be stretched by granular material stuck thereto to dislodge the granular material.

6. An apparatus for handling moistened granular material, which comprises a hopper disposed vertically and having a predetermined taper, a generally tubular liner designed to fit into the hopper and having a greater taper than the hopper, said liner being composed of compressible elastic material, and exclusive fastening means securing only the upper portion of the liner against movement relative to the hopper.

7. An apparatus for handling moistened granular material, which comprises a hopper disposed vertically and having a predetermined taper, a generally tubular liner designed to fit into the hopper and having a greater taper than the hopper, said liner being composed of compressible elastic material, and exclusive liner-mounting means fastening only the upper portion of the liner to the hopper and including bars pressing the upper portion of the liner against the hopper.

8. An apparatus for handling moistened granular material, which comprises a generally vertically extending hopper of generally rectangular shape in transverse cross-section and tapering from a predetermined cross-sectional area at the top thereof to a smaller cross-sectional area at the bottom thereof, a liner generally similar in shape to the hopper and composed substantially of compressible, elastic material, said liner having reinforced corner portions, and exclusive liner-fastening means securing only the upper end of the liner to the hopper, said liner tapering from top to bottom more sharply than the hopper so that the lower portion of the liner is spaced from the hopper.

9. An apparatus for handling moistened granular material, which comprises a conduit having an entrance end and an exit end through which moistened granular material may be advanced, a tubular liner composed of elastic material extending generally along the conduit, said liner having laterally spaced portions extending therealong which have different elasticity from that of the portions of the liner therebetween, and exclusive liner-mounting means securing only the end portion of the liner nearest the entrance end of the conduit to the conduit, whereby the portion of the liner beyond the liner-mounting means is free to stretch and compress to dislodge granular material stuck thereto.

RUSSELL G. FERNALD.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,438,996	Griffin	Dec. 19, 1922
1,570,795	Tainton	Jan. 26, 1926
2,214,533	Fave	Sept. 10, 1940