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MEANS FOR SAMPLING BULK MATERIALS

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3 Sheets-Sheet 1

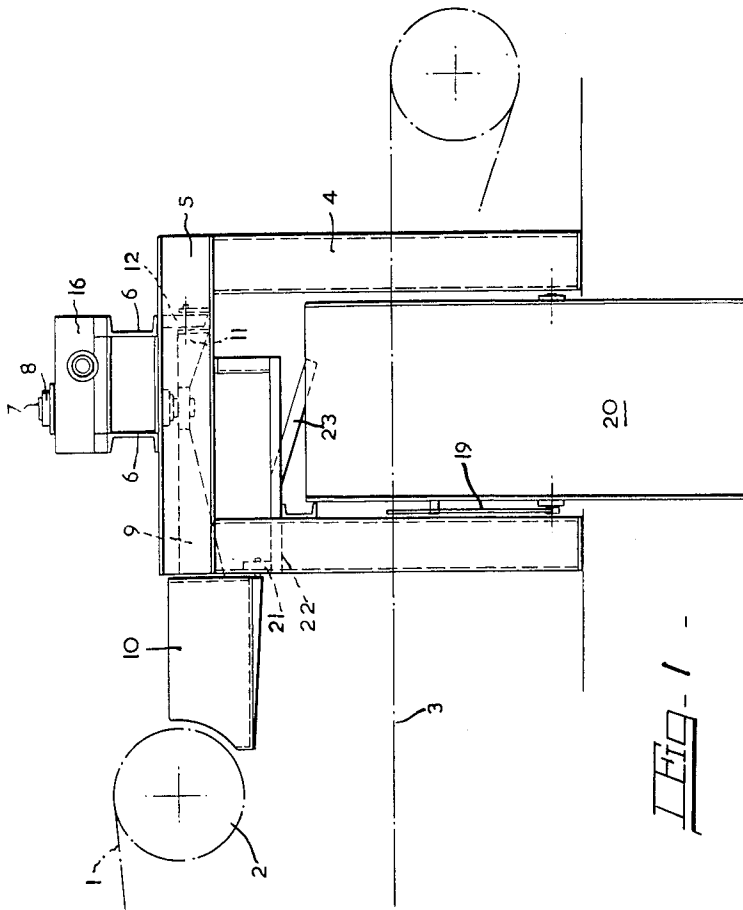


FIG. 1

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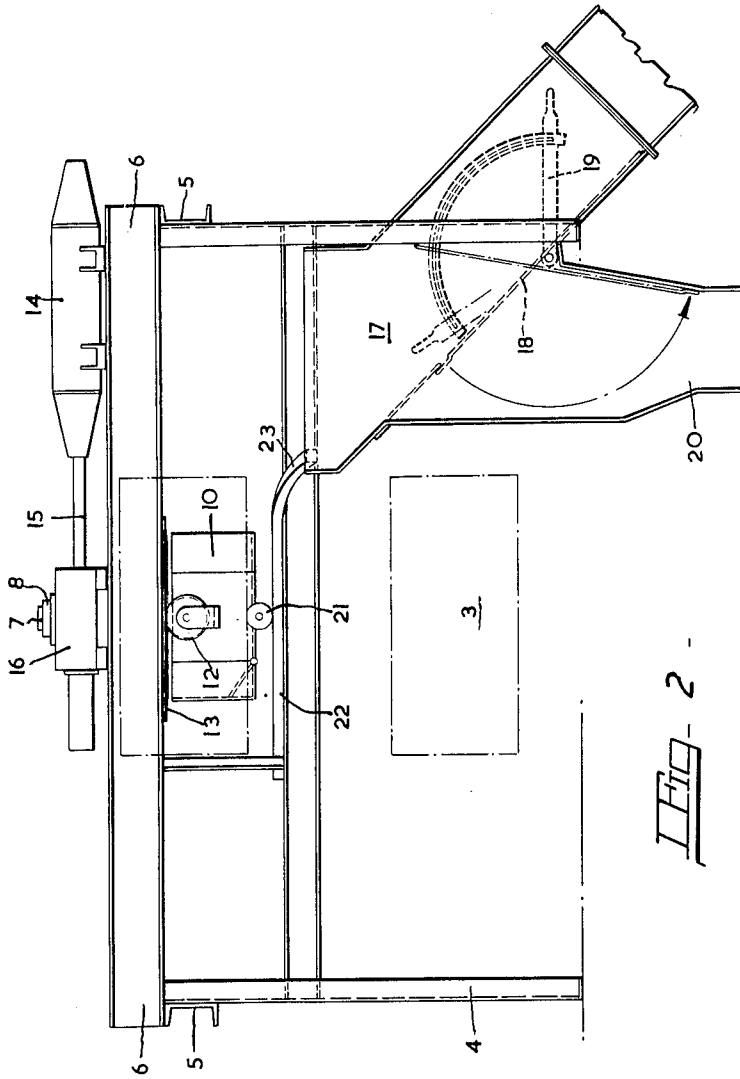
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MEANS FOR SAMPLING BULK MATERIALS

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9 Claims. (Cl. 73-421)

This invention relates to equipment for taking samples from a falling stream of bulk material, such as ores, without disturbing the flow of the material.

Equipment for sampling freely falling streams of bulk material usually include a sampling container that is arranged to be moved at a controlled uniform rate through the falling stream of material to collect a sample extending over the full cross-section of the stream, and the sample is then discharged from the container.

The majority of the materials sampled in this way up to the present only have a maximum particle size of four inches cube, and difficulties arise when attempts are made to sample materials of larger particle size. It is an aim of the present invention to provide equipment that will allow the sampling of bulk material having substantially larger particle sizes, i.e. up to sixteen inches cube or more.

According to the invention equipment for taking samples uniformly from the whole cross-section of a falling stream of bulk material comprises means for forming a falling stream of the material in a predetermined path, a sampling container carried on the end of an arm which is pivoted to swing about a substantially vertical axis adjacent to the path of the falling stream, means for turning the arm about the axis to swing the container through the path, and a receptacle into which the contents of the container are discharged at a point clear of the path.

The arm could perform complete revolutions about the axis, swinging the container through the path of the falling stream at one point in its movement, and discharging into the receptacle at another, but it is preferred to arrange that the arm swings through a limited arc, for example of 180°. The container passes through the falling stream at the midpoint of this reciprocating movement, and is charged either at one end of the swing, or at each end. Where it discharges only at one end, the container will pass twice through the stream between successive discharging operations.

The arm may be counterbalanced by a weight but, according to a further feature of the invention, it is counterbalanced by a further arm carrying a roller engaging a stationary track.

According to a still further feature of the invention the container can be arranged to be discharged automatically at the required angular position or positions in its movement. For example it may be equipped with a hinged door having a roller engaging a stationary track or cam surface that keeps the door closed over the majority of the movement of the arm but drops away in the region of the or each discharge position to allow the door to fall open.

The receptacle into which the container discharges its contents can be a chute guiding the material to further sampling means, with the interposition, if necessary, of a crusher to break it up into finer particles.

The invention will now be further described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a side elevation of an example of equipment according to the invention;

FIGURE 2 is an end elevation, looking from the right in FIGURE 1; and

FIGURE 3 is a plan view of the equipment.

Referring first to FIGURE 1, there is shown on the left-hand side of the figure the end of a conveyor belt 1 which passes over a pulley 2 and discharges from this end a stream of material in the form of particles, such as iron ore. The particle may range in size up to as much as sixteen inches cube. It falls in a stream vertically from this end of the conveyor onto another conveyor 3.

A framework 4 has bearers 5 and 6 supporting a vertical spindle 7 in bearings 8, and this spindle carries a horizontally extending radial arm 9 on the end of which is a sampling container 10. The container is disposed so that, as the arm turns about its pivotal axis, it moves through the path of the material falling from the belt 1, and it is of sufficient size in a radial direction to ensure that it does not miss any of the material, even if the belt is loaded to a substantial depth. Furthermore, it will be seen from FIGURE 3 that the side walls of the container 10 are radial, so that the circumferential width of a zone at any given radius from the axis is proportional to the radius. This means that, since the linear velocity of any given zone of the container is proportional to the radial distance of that zone from the axis (for a constant angular velocity of the arm 9), each zone of the container spends an equal total time in the path of the falling stream of material. This is necessary in order to ensure that the container takes the same amount of material from all zones of the falling stream. If this were not so, and if the larger particles tended to be in the bottom of the stream on the belt 1, and hence nearer to the drum 2 in the falling stream than the smaller particles, a sample showing a false reading of the particle size distribution would be obtained. Likewise, even though the ultimate particle size is itself unimportant (if, for example, the sampled material is to go through a further crusher) an analysis of the composition of the sample will give a false value if, in the original material sampled, the larger particles tend to have a different composition from the smaller ones.

The tilting couple that would otherwise be applied to the bearings 8 by the overhanging weight of the arm 9 and container 10 is relieved by the provision of a further arm 11, extending in the opposite direction to the arm 9 and carrying on its end a roller 12 of conical profile, which bears against the underside of an arcuate track 13.

Angular movement of the arm 9 is achieved by a ram unit or actuator 14 which gives straight line movement to a rod 15 carrying a rack 15a (FIGURE 3) engaging pinion 15b on the spindle 7 within a housing 16 on the bearers 6. In the present example the actuator is an electric one, i.e. it comprises an electric motor moving the rod 15 axially through a screw-and-nut arrangement, but it will be understood that it could instead be a fluid-pressure ram or any other suitable device. Another possibility is to do without the linear actuator altogether and drive the spindle 7 directly through spur reduction gearing from a reversible electric or other motor.

The actuator 14 can turn the spindle 7 through 180°, from a normal rest shown in broken lines in FIGURE 3, through the position shown in full lines, to a reverse rest position also shown in broken lines. The normal rest position is the discharging position, in which the container 10 is over a chute 17, and discharges its contents into that chute to pass to secondary sampling means (not shown). The material may pass first to a crusher to be broken into smaller fragments and then into the secondary sampler, that can be of the kind described and claimed in the specification of our British Patent No. 786,887. The chute 17 includes a flap-valve 18, operated by a handle 19, by which the material can be diverted through a discharge chute 20 when it is not required in the secondary sampler.

The floor of the container 10 is in the form of a door, pivoted at the radially innermost and outermost edge of the container and provided at its radially innermost edge with a roller 21 that moves over a stationary arcuate track 22. The greater part of the track is level, and keeps the roller 21 at such a height that the door is closed, but in the region of the discharge chute 17 the track falls away, as indicated at 23, and so the door automatically opens to discharge the contents as the container reaches this position.

As indicated earlier, this discharging position is the normal rest position of the container. To take a sample of material from the falling stream, the actuator 14 is energised, and it accelerates the container from rest to a speed which is uniform by the time the container enters the path of the falling material. It passes through this path at uniform speed and is then slowed down and halts momentarily at the reverse rest position, then returns by the same path. Again its speed is uniform as it passes through the stream of material. Thus two collections are made on each sampling cycle. As the container returns to its normal position and comes to a halt the door opens and the sample that has been collected is discharged into the chute 17.

It will be understood that by providing a second discharge chute at the reverse rest position and by arranging the door to open also in that position it would be possible to arrange, if desired, that each sample is taken on only a single pass through the falling stream.

We claim:

1. Equipment for taking samples from the whole cross-section of a continuous stream of bulk material falling vertically in a predetermined path comprising a sampling container, an arm carrying said container and pivoted to swing about a vertical axis adjacent to the path of said falling stream between two angularly spaced rest positions, the track of said arm being such as to move said container through the path of said falling stream, and said container having a dimension radially of said axis that is at least equal to the dimension of said falling stream in that direction and said two rest positions being on opposite sides of said path, means to swing said arm between said two rest positions, a receptacle disposed adjacent the path of movement of said container at a point displaced from the path of said falling stream, and means for dumping the contents of said container into said receptacle.

2. Equipment as in claim 1, wherein said rest positions are disposed angularly 180° apart.

3. Equipment as in claim 1, wherein said receptacle is disposed below a point occupied by said container in one of said two rest positions of said arm.

4. Equipment as in claim 1 including means for automatically discharging said container into said receptacle on movement of said container to the region of said receptacle.

5. Equipment as in claim 1, including a discharge door in said container, a roller controlling opening of

said door, and a stationary cam track engaged by said roller, said cam track comprising a first portion serving to hold said door closed over the greater part of the movement of said container and a second portion shaped and positioned to allow said roller to open said door when said container is positioned over said receptacle.

6. Equipment as in claim 1, wherein said container is of wedge shape, bounded, in plan view, by inner and outer arcuate walls, substantially concentric with said axis and by radial walls, whereby the circumferential horizontal zone of each arcuate zone of said container is proportional to the distance of said zone from said axis.

7. Equipment as in claim 1, wherein said arm-swinging means comprise a linear actuator, a rack moved by said actuator and a pinion engaged by said rack, said pinion being mounted to turn about said axis and being connected to said arm.

8. Equipment for taking samples from the whole cross-section of a continuous stream of bulk material, falling vertically in a predetermined path comprising a sampling container, an arm carrying said container and pivoted to swing about a vertical axis in a path that carries said container through the path of said falling stream, said container having a dimension radially of said axis that is at least equal to the dimension of said falling stream in that direction, means for turning said arm about said axis, a receptacle disposed at a point in the path of said container displaced from the path of said falling stream, and means for dumping the contents of said container into said receptacle, said container having oppositely inclined side walls so that the end wall adjacent the edge of the stream which is furthest from said vertical axis is longer than the other end wall whereby the container extracts the same amount of material from all zones in said vertical path.

9. Apparatus for taking samples from the entire cross-section of a vertically falling stream of bulk material comprising an upwardly open container mounted for rotation about a vertical axis closely adjacent said stream, said container being substantially wedge shaped with its smaller end located nearer said axis so as to take substantially the same amount of material from each zone of said stream radially of said axis, and means automatically effective after the container has passed at least once entirely across said stream for dumping the contents of said container into a receptacle or the like.

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