March 7, 1933. J. H. MORROW 1,900,458

ROLL FEEDER

Filed June 13, 1931

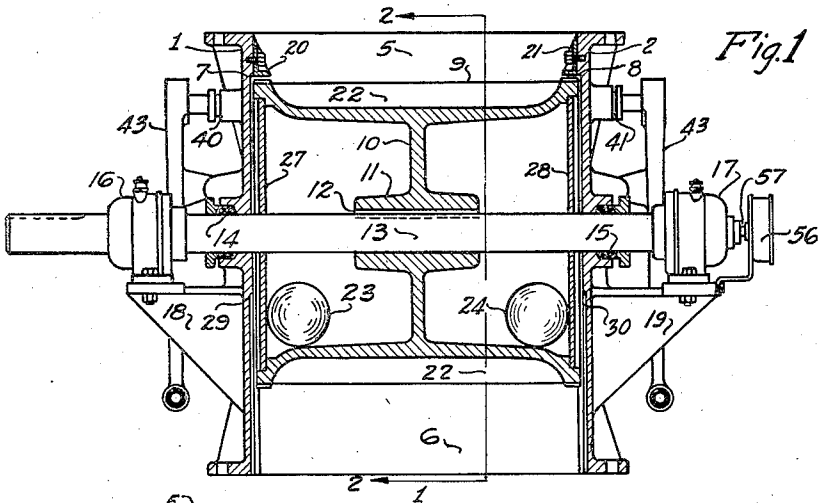

Fig. 1

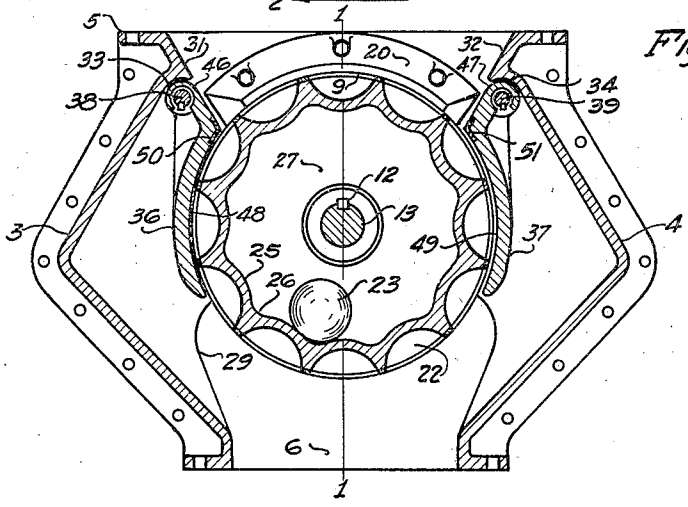

Fig. 2

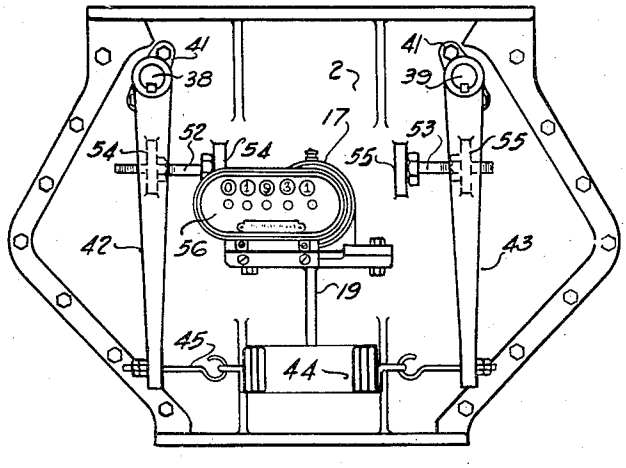

Fig. 3

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UNITED STATES PATENT OFFICE

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ROLL FEEDER

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This invention relates to roll feeders, and more particularly to a feeder for handling measured quantities of dry, pulverized materials. The feeder is especially intended for handling materials such as cement, cement raw material, pulverized fuels and lime at a uniform rate and to overcome the tendency of such materials to flood.

Dry, pulverized materials have a tendency under certain operating conditions, to absorb and retain air and in this condition an apparently dense mass may assume the characteristics of a thin liquid. This is frequently caused by a slide of material or the collapse of an arch formed at or near the bottom of a storage bin, which causes air to mix with the lowermost materials in storage, due to the pressure or head of materials above the arch. This condition may be aggravated by the use of compressed air to overcome the friction between the mass of material and the walls of the bin in order to cause the material to discharge freely.

These aerated materials under pressure head or at a difference in level will discharge through very small openings, and may attain almost the same level in an adjacent container, to which the storage bin may be connected. Screw, star and roll feeders, of which I am aware, although satisfactory for the handling of relatively coarse materials, cannot handle fine materials either without flooding or at a reasonably uniform rate.

The lack of uniformity of feeding of the usual star or roll feeders is further aggravated by the tendency of materials to become wedged or packed in the pockets so that they do not discharge freely. Wear and power requirements are excessive, as material tends to pack between the ends of the roll and the walls of the feeder casing.

In accordance with the present invention, both sides of the roll are effectively sealed by the material itself, and a symmetrical arrangement permits rotation of the roll in either direction. The pockets are filled uniformly without wedging or packing and at the discharge orifice they are emptied completely, together with any dust that might tend to accumulate between the ends of the roll and the walls of the casing. The parts are arranged to avoid actual contact of metal surfaces with the roll, in order to reduce wear and means are provided to maintain the seal, as the parts become worn due to the abrasive effect of the material handled.

The invention comprises in general a hollow casing having a material opening protected by renewable wearing surfaces, having sharply inclined inner walls, to permit the free flow of material downwardly toward the roll. The end walls of the casing are provided with a substantially circular recess of a diameter slightly larger than the roll, which is mounted for rotation upon a shaft supported in outboard bearings beyond the walls of the casing. The roll is preferably a steel casting of relatively thin section for elasticity, and is provided with closely spaced longitudinal pockets, the cross-section of which is preferably less than a semi-circle, to reduce their tendency to retain material when inverted. The pockets extend lengthwise slightly beyond the lower edge of the wear plates, in order to permit close clearances between the roll and the upper portion of the end-walls of the casing to avoid discharge of aerated materials at the ends of the roll.

The roll is supported by a central disc cast integrally and provided with an enlarged sleeve at its center, which is keyed to the shaft. Each end of the roll is closed preferably by a thin and elastic steel disc. The roll is otherwise hollow, and its inner surface is irregular and preferably conforms substantially to the curvature of the pockets. One or more balls of iron or other heavy material resting freely within the roll and dropping from one low point to another during rotation serves to discharge the pockets completely. The inner surface of the roll is slightly inclined from the center, to cause the balls or weights also to rap against the thin discs at the ends to prevent the accumulation of dust, which is discharged through recesses formed in the end-walls below the center of the roll.

In order to fill the pockets uniformly, and to effect the material seal, follower plates are

provided at each side of the roll. These plates are preferably similar and their inner surfaces conform in curvature to the roll, but are spaced a slight distance from it to prevent actual contact of metal to metal, this distance being variable as hereinafter described. The depth of the plates is sufficient to cover at least two pockets to maintain the seal and to prevent a free discharge of material. The followers are provided with sharp leading edges to scrape and cause the pockets to fill uniformly without wedging. The upper edge of each follower plate is enlarged and provided with a bore to receive a supporting shaft, to which it is keyed. This shaft extends through stuffing boxes preferably at each end of the casing and levers of appreciable length are connected at their ends by a coil spring to maintain the plates in normal position.

Stops are arranged to prevent the springs from drawing the plates into contact with the roll, the stops being made adjustable in order that the proper clearance may be maintained and to compensate for wear. A further purpose of the coil spring is to prevent injury to the feeder or driving mechanism by foreign materials such as tramp iron, which may be caught in the pockets, as the follower plate may swing outwardly to discharge this matter. The side walls of the casing are flared outwardly to permit the follower plate to swing through a considerable arc.

The sharp leading edge of the follower plate, and the uniform filling and discharging of pockets, results in a high volumetric efficiency with an average error less than 2% by weight and the feeder can accordingly be calibrated by a simple revolution counter. It is thus well adapted for feeding cement or cement raw materials for final grinding to tube mills, for measuring raw materials for blending, and for feeding powdered fuels to furnaces.

Further objects and advantages of the invention will be apparent from the accompanying drawing, in which

Fig. 1 is a cross-section on line 1—1 of Fig. 2,

Fig. 2 is a cross-section on line 2—2 of Fig. 1, and

Fig. 3 is a rear elevation.

Referring to the drawing, the apparatus is seen to consist of a casing having a front wall 1, an end wall 2 and outwardly flared side walls 3 and 4. The upper portion of the casing is provided with a flanged inlet 5 and the lower portion with outlet 6, for the material handled.

The end walls 1 and 2 are provided with circular recesses 7 and 8, arranged to receive the ends of the roll 9. The roll is preferably made of cast steel of relatively thin section and includes a central, integrally cast disc 10, provided with a sleeve 11, having a central bore, the roll being keyed for rotation as at 12 to the drive shaft 13. The drive shaft passes through stuffing boxes 14 and 15 in the end walls 1 and 2 and is supported in outboard bearings 16 and 17, aligned on brackets 18 and 19, preferably cast integrally with the end walls.

In order to protect the inlet from abrasion, at the point of greatest wear, renewable members 20 and 21 are secured to the end walls 1 and 2. These members have sharply inclined inner surfaces to permit a free flow of material toward the roll. They are curved to conform to the latter and overhang the ends of the roll to hinder the entrance of material between the ends of the roll and the walls of the casing.

The roll is provided with closely spaced longitudinal pockets 22, which extend slightly beyond the lower edges of the members 20 and 21. The cross-section of the pockets 22 is preferably less than a half circle, in order to overcome the tendency of materials to bind or bridge and remain in the pockets after the latter pass the discharge orifice. The inner surface of the roll 9 is irregular and preferably corresponds in curvature to the pockets, in order that weights 23 and 24, which may be cast-iron balls or other heavy material, may drop from high points as 25 to low points 26 during rotation of the roll.

As the roll is preferably made of cast steel of relatively thin section, it is sufficiently elastic to vibrate slightly from the dropping of the weights, to discharge the material at the outlet 6, the slight drop of the balls being insufficient to set up unfavorable vibration which might injure the bearing surfaces or accessory equipment.

The thickness of the roll 9 decreases from the center toward the ends in order to cause the balls 23 and 24 to rap against relatively thin steel plates 27 and 28, which close the end of the roll and are accommodated in recesses therein.

Below the level of the shaft 13, the inner surfaces of the end walls 1 and 2 are further recessed as at 29 and 30, in order to form a free discharge for materials which would otherwise accumulate between the ends of the roll and the walls. The occasional rapping of the balls 23 and 24 against the thin steel discs 27 and 28 loosens the material and causes it to discharge freely through the recesses 29 and 30.

At the inlet, the inner surfaces of the side walls 3 and 4 incline downwardly as at 31 and 32 and are reversely curved at 33 and 34 to conform to the ends of follower plates 36 and 37, these plates being keyed to shafts 38 and 39. The shafts 38 and 39 pass through stuffing boxes 40 and 41, arranged in the end walls 1 and 2, where they are keyed to parallel levers 42 and 43.

A relatively heavy coil spring 44 connects

the ends of the crank arms 42 and 43 and maintains them and likewise the follower plates 36 and 37 in their innermost positions, the tension of the spring 44 being variable by means of the screw hooks as at 45.

The upper inner surfaces 46 and 47 of the follower plates are inclined downwardly toward the roll and form extensions to the inner surface of the inlet. The lower portion of the inner surfaces of the follower plates are curved as at 48 and 49 to conform to the roll 9, and are of a depth to cover at least two pockets 22 in order to form a seal of material to prevent flooding. The follower plates are provided with sharp leading edges 50 and 51, one of which, depending on the direction of rotation of the roll 9, serves to scrape excess material across the pockets, so that the latter are filled with a uniform quantity of material without wedging or packing the latter. The leading edges 50 and 51 are preferably protected by a wear-resisting alloy, such as that commonly known as stellite, to prevent rounding of these edges due to abrasion. The spaces between pockets are preferably likewise protected. I have found that rounded leading edges tend to wedge or pack material in the pockets with the result that the latter fill at varying quantities and the rate of handling is further varied by the tendency of material to stick to the surfaces of the roll.

In order to prevent actual contact between inner surfaces 48 and 49 and the outer surface of the roll 9, adjustable stops are provided as indicated particularly in Fig. 3. These may comprise bolts 52 and 53, which are threaded in bosses 54 and 55 on the inner sides of levers 42 and 43. The heads of these bolts may abut bosses 54 and 55, cast integrally with the end walls 1 and 2. By this means, any desired clearance between the follower plates and the roll may be maintained and compensation made for wear of the parts.

As the levers, stops and connections are arranged similarly beyond each end wall, 1 and 2, only one end has been shown and described in detail.

In the preferred form of my invention, as described, the follower plates are similar and their related operating parts are identical, but it is to be understood that one of these plates might be fixed or simply adjustable; or that the lever and spring tension device might be omitted at one end of the casing to obtain many of the advantages of my invention over the prior art and without departing from the spirit of the invention.

In operation, my apparatus may be installed below a bin or conveyor, so that the material to be handled will descend by gravity to the roll and be discharged therefrom to another conveyor, an air stream or a receptacle. The sharply inclined walls of the inlet prevent arching of material above the roll and permit a uniform deposit in each pocket, which is scraped at a constant level without packing, by the leading edge 50 or 51 of the follower plate, depending upon the direction of the rotation of the roll 9. As the lower surfaces 48 and 49 of the follower plates are held closely adjacent to and conform to the curvature of the roll, aerated material cannot leak or flood toward the discharge outlet, as the weight of material is evenly deposited upon the roll, and as the pockets are shallow, the material seal formed by the covering of two pockets prevents the common tendency of most roll feeders to spin after the power has been shut off, due to the weight or head of material or for the roll to run at a greater rate than desired.

As the follower plates are held at their innermost positions, under the heavy tension of the coil spring 44, the roll is sealed at each side. Tramp iron or other foreign material, of large enough size to injure the parts, is discharged by outward movement of the follower plate on the operating side, the latter returning to its normal position immediately after the pocket has cleared the end of the plate.

In view of the above, it will be evident that this feeder has a high volumetric efficiency, and as the pockets are filled with uniform quantities, without wedging, the density remains constant, so that the weight of materials discharged may be calculated with very slight error. Accordingly, a simple revolution counter, as indicated at 56, may be coupled to the driven shaft 13, as at 57, to calibrate the feeder.

I claim:

1. A feeder for handling fine materials at a uniform rate, comprising the combination of a casing having an inlet and an outlet, a hollow roll arranged for rotation between the inlet and the outlet, the surface of the roll being provided with pockets of uniform size to receive the material, a follower plate closing one side of the inlet movably mounted near one side thereof having a portion of its inner surface conforming to the curvature of the roll, and of a depth sufficient to cover at least two pockets, means normally maintaining the follower plate in an inward position near the surface of the roll, the roll having an irregular inner surface and a relatively thin section and provided with circumferential channels at the ends of the roll, the ends of the roll being closed by thin discs, and balls freely movable in said channels within the roll to engage and vibrate both the latter and the discs.

2. A feeder for handling fine materials at a uniform rate, comprising the combination of a casing having an inlet and an outlet, a hollow roll arranged for rotation between the inlet and the outlet, the surface of the

roll being provided with pockets of uniform size to receive the material, a follower plate closing one side of the inlet movably mounted near one side thereof, having a portion of its inner surface conforming to the curvature of the roll, and of a depth sufficient to cover at least two pockets, means normally maintaining the follower plate in an inward position near the surface of the roll, the roll having an irregular inner surface and a relatively thin section and being supported on a driven shaft by a central disc dividing the roll into two compartments, the thickness of the roll decreasing from the central disc toward thin discs which close the ends of the roll, and a ball in each compartment, freely movable therein and normally contacting both with the inner surface of the roll and the end disc of said compartment, said ball vibrating both the roll and the disc as it moves around during rotation of the roll.

3. A feeder for handling materials at a uniform rate, comprising the combination of a casing having an inlet and an outlet, a hollow roll arranged for rotation between the inlet and the outlet, the surface of the roll being provided with closely spaced pockets of uniform size to receive the material, similar follower plates arranged at each side of the roll and mounted at their upper edges near the inlet for swinging movement, each follower plate having a portion of its inner surface curved to conform to the roll and of a depth sufficient to cover at least two pockets thereof, means normally maintaining the follower plates in inward positions near the roll, the roll being supported on a driven shaft by a central disc cast integrally with the roll, and dividing the latter into two compartments, the roll being of relatively thin section, decreasing in thickness toward the ends, and having an irregular surface conforming substantially to the curvature of the pockets, the ends of the roll being closed by relatively thin discs, and a ball freely movable in each compartment, said ball normally contacting with both the roll and the end disc of its compartment during rotation of the roll, said ball being effective to vibrate the pockets and the disc.

4. A feeder for handling fine materials at a uniform rate, comprising the combination of a casing having an inlet and an outlet, and circular recesses in the end walls thereof, a hollow roll arranged for rotation between the inlet and the outlet and extending into said recesses, similar follower plates closing each side of the inlet, secured at their upper edges to shafts supported for rotation in and passing through the end walls of the casing, both ends of each shaft being provided with arms, spring means connecting the arms at each end of the casing, each follower plate having a portion of its surface conforming to the curvature of the roll and of a depth sufficient to cover at least two pockets, said surface having a sharp leading edge, the roll being provided with closely spaced longitudinal pockets of uniform size and having a central supporting disc dividing it into two compartments and secured to a driven shaft, the latter passing through the walls of the casing and mounted in bearings on opposite sides thereof, the ends of the roll being closed by relatively thin discs, the roll having a relatively thin section and an irregular inner surface, conforming substantially to the curvature of the pockets, the thickness of the roll decreasing from the center toward the ends, a ball freely movable in each compartment and engaging both the roll and the end disc of said compartment to vibrate the pockets and the disc.

5. A feeder for handling fine materials, which comprises a casing having end walls and sloping side wall surfaces defining an inlet hopper, the end walls being provided with circular recesses, a hollow roll arranged for rotation below said hopper and extending into the recesses, the roll being provided with pockets of uniform size to receive the material, a pair of plates mounted in the casing at opposite sides of the roll, each plate having a sloping portion serving as a continuation of one of said sloping wall surfaces of said hopper, and a curved portion conforming to the curvature of the roll and extending around the latter to an extent sufficient to cover at least two pockets in the surface of the roll, at least one plate being mounted to swing around the top edge of its sloping portion as a center toward and away from said roll, means acting on said plate and resiliently forcing it toward the roll, the roll having a relatively thin, elastic section and an irregular inner surface, the ends of the roll being closed by discs, the end walls of the casing being provided with outlet recesses communicating with but extending below the first named recesses, and movable weights within the roll actuated by the irregular surface to vibrate the pockets and discharge material therefrom and to vibrate the discs to discharge material accumulating in the first named recesses through the last named recesses.

In testimony whereof I affix my signature.

JOSEPH H. MORROW.