Jan. 27, 1948. L. E. HARPER 2,435,039

DISK FEEDER HAVING MATERIAL SCRAPER AND MATERIAL AGITATOR

Filed Jan. 12, 1944 3 Sheets-Sheet 1

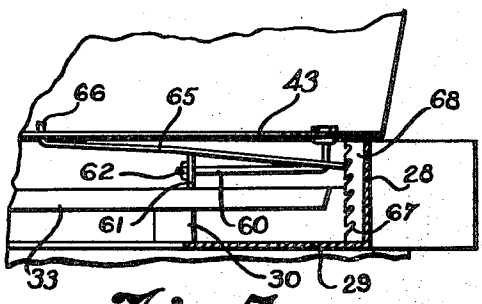


Fig. 5.

Fig. 1.

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Filed Jan. 12, 1944 3 Sheets-Sheet 2

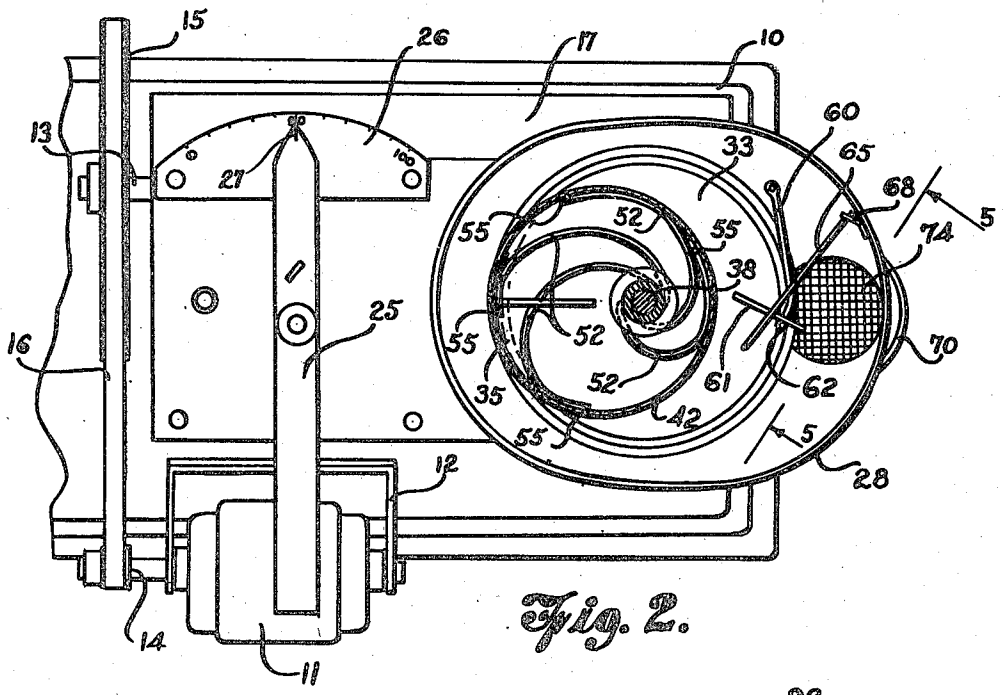


Fig. 2.

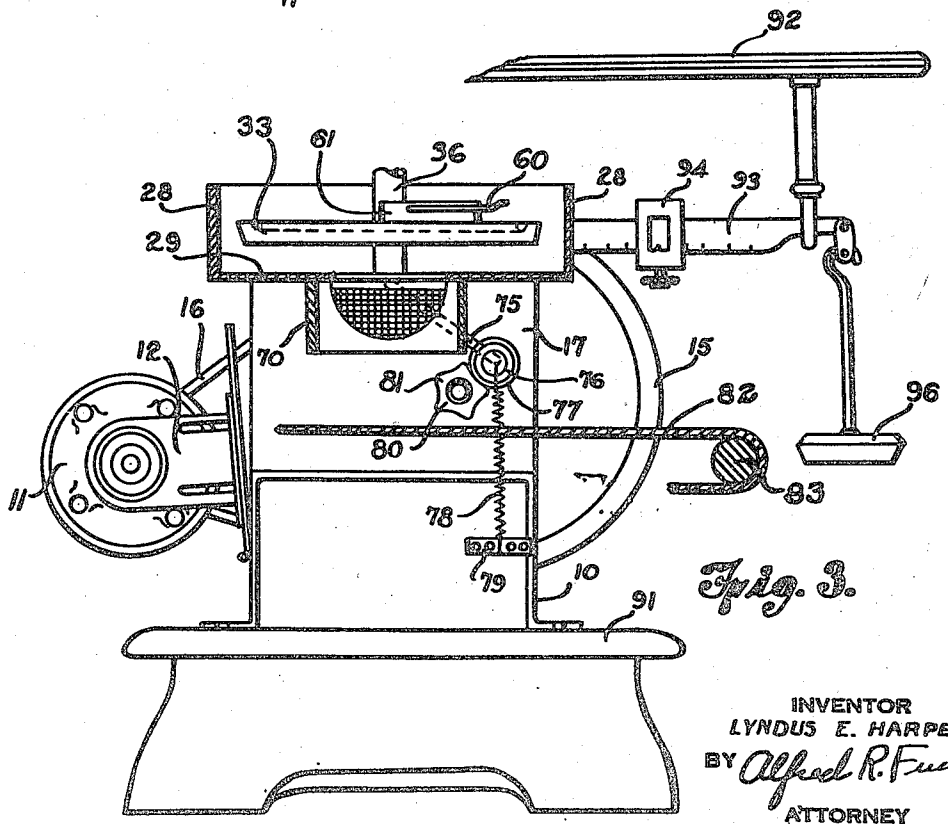


Fig. 3.

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Filed Jan. 12, 1944 3 Sheets-Sheet 3

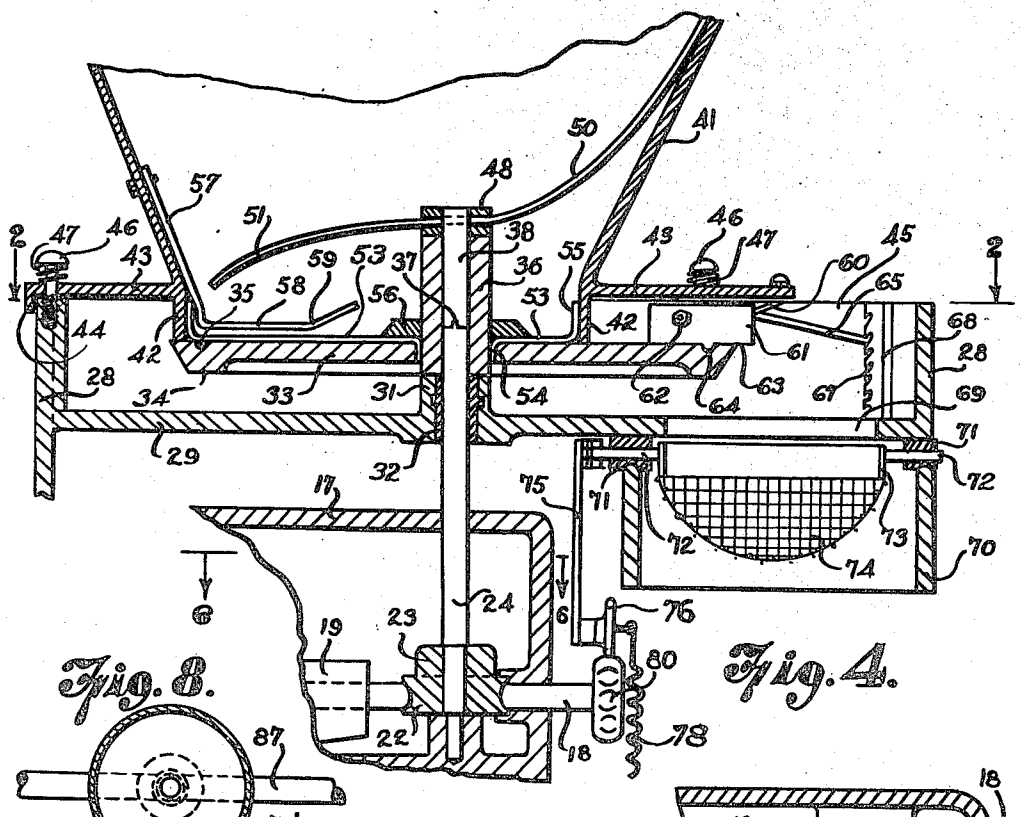


Fig. 4.

Fig. 8.

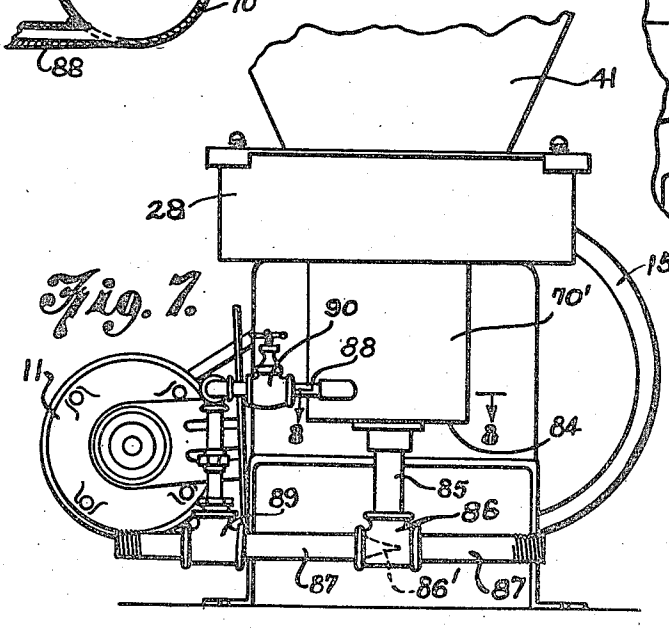


Fig. 7.

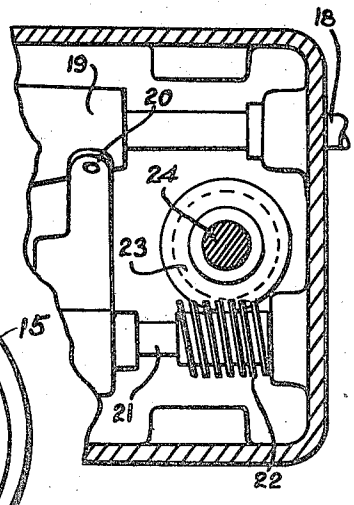


Fig. 6.

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Patented Jan. 27, 1948

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UNITED STATES PATENT OFFICE

2,435,039

DISK FEEDER HAVING MATERIAL SCRAPER AND MATERIAL AGITATORS

Lyndus E. Harper, Kansas City, Mo., assignor to Omega Machine Company, Kansas City, Mo., a corporation of Missouri

Application January 12, 1944, Serial No. 518,019

5 Claims. (Cl. 222—216)

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My invention relates to feeding devices, and more particularly to a grooved disk feeder.

It is a purpose of my invention to provide a feeding device that is adapted to accurately feed very small quantities of finely divided material at a controlled rate, comprising a hopper that has a bottom that is rotatable, and which bottom is provided with an annular groove therein that is of uniform cross section, said bottom member and the bottom portion of said hopper being so related to each other that a portion of the bottom member having the groove therein is within the hopper and a portion thereof is outside the hopper, and to provide means engaging the bottom member of the hopper for removing the material from the groove therein to discharge the same onto or into a device to which the finely divided material is to be fed.

It is a particular purpose of my invention to provide means for controlling the feed of said material, comprising means for rotating the bottom member at a controlled rate, which means is adjustable and which, preferably, comprises a variable speed transmission means and means for adjusting the same to obtain the desired rate of feed of said device.

It is a particular purpose of my invention to provide in a device of the above mentioned character a hopper that has a vertical wall portion, or substantially vertical wall portion at the bottom thereof, the bottom edge of which is held in firm contact with the substantially plane top face of the bottom wall member of the hopper so as to provide a tight joint preventing escape of the finely divided material between said plane top face of said bottom wall member and the bottom edge portion of the substantially vertical wall of said hopper, said means, preferably, comprising means for exerting a pressure between said bottom and vertical wall portions, which means, preferably, comprises resilient means for yieldingly holding said hopper in engagement with the bottom wall member and exerting sufficient pressure thereon to provide a tight joint between the body portion of the hopper and said bottom wall. Said bottom edge of said substantially vertical wall portion also serves as means for leveling off the material that will accumulate in the annular groove in said bottom member as the same leaves the hopper during the rotation of said bottom member relative to the body portion of the hopper, so that the same quantity of material is discharged from the hopper per unit of length through the groove due to rotation of said bottom wall member at all times, the groove being, of course, of uniform cross section throughout.

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The relationship of the body portion of the hopper and the bottom wall member and the resilient means is such that the yielding or resilient means will compensate for any wear of the parts that might otherwise prevent a tight joint between the bottom wall and the remainder of the hopper that might cause leakage of the finely divided material between the top substantially flat or plane face of the bottom wall and the bottom edge of the substantially vertical wall of the hopper contiguous to said bottom wall.

It is another purpose of my invention to provide means for removing the material from the groove at a predetermined station or location, so that as the groove passes this station or location all of the material will be removed from said groove and discharged from the bottom wall over the edge thereof to pass by gravity toward the device or apparatus into or onto which the finely divided material is to be fed, said means comprising a scraper member that has a portion that engages the top face of said bottom wall and which has a downwardly projecting portion of the same cross sectional shape as the cross sectional shape of the groove engaging in said groove, so as to remove all of the material therefrom as the same contacts said scraper member, so as to cause said material to travel over the top face of said bottom wall, as said bottom wall rotates, and outwardly toward the peripheral edge or rim thereof to drop off said rim or edge by gravity.

It is another important purpose of my invention to provide means for obtaining a substantially even distribution of the material discharged by the above referred to scraping means from the rotatable bottom wall member, onto or into a member to which the material is fed, comprising a sifter or screen that is shaken constantly to spread or evenly distribute the material that is being discharged from the edge of the disk onto or into a member located below said sifter or shaking screen member.

It is still a further purpose of my invention to provide a device of the above mentioned character, in which the rate of rotation of the rotatable bottom wall member can be varied to any extent desired to obtain the desired rate of feed of the material from the rotatable bottom wall member between a quantity approaching zero and a predetermined maximum rate of feed for the feeder, comprising variable speed transmission means, the output shift of which drives

said rotatable feeding member, said driving means comprising a shaft that is driven at substantially a constant rate of speed, which rotates the rotatable feeding member through said variable speed transmission, and which is provided with means rotating therewith that operates the sifter or shaking device at substantially a uniform rate of oscillation or shaking, no matter what the rate of rotation of the rotatable feeding member may be.

It is another important purpose of my invention to provide means for removing the finely divided material from the rotatable feeding member, to discharge the same therefrom, comprising a scraper member, and means for holding the scraper member in contact with the surface of the rotatable feeding member and in position in engagement with the walls of said groove, which is wear compensating so that said scraper will be in constant engagement with the walls of the groove and the top face of the rotatable feeding member, said means comprising a member that exerts pressure on said scraper member, which, preferably, is resilient means exerting a downward pressure on said scraper member, so that the bottom edge thereof will be held under a predetermined pressure in contact with the surfaces from which the material is to be scraped, and to provide adjusting means for said resilient means.

It is another purpose of my invention to provide means within the hopper engaging the top surface of said bottom wall member in such a manner as to completely fill the groove in said bottom wall member before said groove leaves the confines of said hopper, so as to assure a uniform quantity of material is leaving said hopper per unit of length of said groove as said groove passes out of the hopper during rotation of said rotatable member.

Said hopper is further, preferably, provided with means for agitating the contents thereof so as to provide a uniform feed by gravity of the finely divided material onto said rotatable bottom member, comprising a plurality of agitator members rotating with said rotatable bottom member and a fixed agitator member on said hopper, said rotatable agitator members comprising a member directed away from said rotatable bottom wall member into the upper portion of said hopper, and a member directed toward said bottom wall member, but spaced therefrom.

It is a specific purpose of my invention to provide a device of the above mentioned character, in which the rotatable bottom member is made in the form of a disk having an annular groove therein concentric with the center thereof closely adjacent the periphery of said disk, said hopper having a wall portion at the bottom end thereof that has a substantially vertically extending portion that is substantially annular in character, the axis of rotation of said disk-like member being eccentric to the center of said annular wall portion of said hopper, so that a portion of said disk having the groove therein lies within the hopper and a portion thereof lies externally of said hopper.

My invention is adapted for feeding finely divided material to other finely divided or similar material that is in a dry state, by feeding the same onto moving means carrying said material to which the finely divided material is fed, and is also adapted for feeding finely divided material of a soluble character into a liquid, comprising means for agitating the liquid after the finely divided material passes into the same so as to provide a uniform mixture of said soluble finely divided material and said liquid, and so constructed and arranged as to feed said soluble finely divided material into the main stream of said liquid at a substantially uniform rate.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described, except as defined in the claims.

In the drawings:

Fig. 1 is a view partly in elevation and partly in section, partly broken away, of my improved feeding device.

Fig. 2 is a view partly in horizontal section, taken substantially on the line 2—2 of Fig. 4, and partly in elevation, of the feeding device shown in Fig. 1, partly broken away, the cover plate of the feeder being omitted.

Fig. 3 is a view partly in vertical section and partly in elevation, taken substantially on the line 3—3 of Fig. 1, the hopper being omitted and the upper part of the feeding device being broken away.

Fig. 4 is a fragmentary vertical sectional view on an enlarged scale through the feeding device and a portion of the variable speed transmission means for driving the same.

Fig. 5 is a fragmentary view partly in section, taken substantially on the line 5—5 of Fig. 2.

Fig. 6 is a fragmentary sectional view through the variable speed transmission driving means, taken substantially on the line 6—6 of Fig. 4.

Fig. 7 is a fragmentary elevational view of a modified form of feeding device, and

Fig. 8 is a section taken substantially on the line 8—8 of Fig. 7.

Referring in detail to the drawings, my improved feeding device comprises a frame 10, which has a motor 11 mounted thereon, said motor being mounted on a bracket 12 on said framework. The motor drives a shaft 13 through the pulleys 14 and 15, over which the belt 16 operates. Said shaft 13 is the drive shaft of a variable speed transmission device mounted in a housing 17 on the frame 10. Said variable speed transmission is constructed in a manner similar to that shown in my application Serial No. 500,082, filed August 26, 1943. The input shaft is operated by drive shaft 13 at a uniform speed and is indicated by the numeral 18 in Fig. 6 and has mounted thereon a plurality of cams, such as the cam 19, with which followers 20, such as disclosed in my above referred to copending application, cooperate to drive the output shaft 21, which is provided with a worm 22 meshing with the worm wheel 23 on the shaft 24. The position of the followers relative to the cams is adjustable in a manner described in said co-pending application by means of a lever 25 provided in a convenient location, preferably, on the top of the housing 17, a suitable scale or dial 26 being provided, with which a pointer 27 on the lever 25 cooperates to indicate the setting of the variable speed transmission device to obtain the desired rate of feed of the apparatus, as will be explained below. The rate of feed of the apparatus is dependent upon the rate of rotation of the shaft 24 and the rate of rotation of the shaft 24 is dependent upon the adjustment of the followers relative to the cams, and accordingly the scale or dial 26 can be calibrated to indicate rate of feed in any suitable units directly, if this is desirable.

Mounted upon the housing 17 is a housing 28,

which is substantially of an elliptical shape, as will be obvious from Fig. 2. Said housing has a transverse wall 29 provided with a bearing 30 for the shaft 24, said bearing, preferably, comprising a boss 31 extending upwardly from the transverse wall 29 and serving as a spacing member within which is mounted a bearing member 32 of anti-friction metal, the details of construction of the bearing being shown in Fig. 4. Rotatably mounted on the boss 31 is a disk-like member 33, said disk-like member being provided with a depending annular reenforcing rib 34 and an annular groove 35 opposite said reenforcing rib in the top face thereof. The top face of said disk-like member is faced off so as to be substantially plane or flat, except for the annular groove 35, which is machined so as to be of uniform cross section throughout its entire length.

Extending upwardly at the axial center of the disk-like member 33 is a tubular sleeve-like extension 36. The shaft 24 extends into this tubular member 36 and has a transversely extending rib portion 37 thereon that is seated in a transversely extending groove in the lower end of the stub shaft 38, which is fixed to the sleeve-like member 36 so as to rotate therewith, thus providing a detachable connection between the disk-like member 33 and the shaft 24, permitting said disk-like member to be readily placed in position on the upper end of the shaft 24 projecting above the top of the transverse wall 29, said disk-like member 33 thus being driven by said shaft 24 at the rate of rotation thereof.

Said feeding device is provided with a hopper having an upper substantially cylindrical body portion 39 provided with a removable cover member 40 and a lower tapering body portion 41 terminating in an annular substantially vertical wall portion 42, which is, preferably, circular, but of considerably smaller radius of curvature than the disk-like member 33. The bottom edge of the vertical wall portion 42 is finished off to lie in a plane so that the same will have closed contact with the top face of the disk-like member 33, which comprises the bottom member of the hopper. Said lower body portion 41 is provided with a laterally extending flange 43, which is provided with a depending lip 44 overlapping the vertical housing 28, said flange 43 thus providing a cover member for said housing overlying the disk 33, but not extending over the entire housing so that the operation of the apparatus can be observed through the opening 45 thus provided. A plurality of screw-threaded headed members 46 are provided mounted in the vertical wall portion of the housing 28, coil springs 47 being provided between the heads on the members 46 and the flange 43 to thus hold the bottom edge of the annular wall 42 in such tight engagement with the plane top surface of the disk, that the finely divided material in the hopper will not escape between the bottom edge of the vertical wall portion 42 and the flat or plane top surface of said disk-like member 33. The proportion of the parts is such that when the wall portion 42 is in engagement with the top of the disk the wall portion 43 will not be in engagement with the top edge of the vertical wall 28 of the housing.

The shaft portion 38 has a collar 48 fixed thereto at its upper end. Agitator members are provided in the hopper and these are secured to the collar 48 and, preferably, comprise an upwardly and outwardly curved agitator member 50, which is made of flexible material, such as spring wire,

engaging the tapering wall 41 of the hopper, and a downwardly and outwardly curved flexible agitating member 51, also made of such material as spring wire, which extends downwardly toward the top surface of the disk-like member 33, but is spaced therefrom. A plurality of agitator members is also provided sweeping the top surface of the disk-like member 33 to assure filling of the groove 35, said agitator members 52 being also made of spring wire and being curved as shown in Fig. 2, the normal curvature of said members being substantially that shown for the two agitator members 52 on the left side of the shaft 38. Each of said agitator members 52 comprises a portion 53, which extends parallel to the top face of the disk 33, a depending end portion 54 mounted in an opening in the disk 33 adjacent the tubular member 36, and an upstanding end portion 55, which is in engagement with the wall 42. A collar 56 is also, preferably, provided on the member 36, which has slots in its bottom face accommodating the wire agitator members 52. Cooperating with the agitator members 51 and 52 is a fixed agitating member 57, which is secured to the hopper wall 41 and has a portion 58 that extends substantially parallel to the top face of the disk-like member 33 and a slightly upturned end portion 59 at the end thereof nearest the sleeve-like member 36. The rotatable members 51 and 52 in cooperation with the stationary member 58 thoroughly agitate the material near the bottom of the hopper and cause the groove 35 to be completely filled.

It will be noted that as the upturned portions 55 of the agitator members 52 slide along the wall 42 (see Fig. 2), due to the fact that the parallel wall portion 42 is eccentric to the axis of rotation of said members, these will be flexed so as to be bent considerably out of their normal shape on the right hand side of the hopper, as viewed in Fig. 2, which causes a sliding movement of the members 52 relative to the top face of the disk-like member 33 and thereby causes said members 52 to cross the annular groove 35 twice during each rotation of the apparatus comprising the disk-like member 33 and the parts rotating therewith. Thus, although the agitator members 52 rotate with the disk-like member, the same also move relative to the disk-like member to aid in filling said groove 35 uniformly.

Mounted on the flange-like cover member 43 is a rod-like member 60 constituting a bracket, upon which the scraper member 61 is mounted. Said rod-like member has a threaded end extending through an opening in the scraper 61 and a nut 62 is screw-threaded thereon for holding the scraper 61 from being carried along with the disk 33 in its rotation with the shaft 24. The bracket 60 extends through an opening in the cover 43 and there is sufficient looseness of the parts that said bracket 60 can go through a swinging movement permitting movement of the scraper 61 relative to the cover member 43 toward and away from the disk-like member 33.

Said scraper has a substantially straight bottom edge 63, which engages the flat top face of the disk-like member 33 and a downward projection 64 conforming in shape to the cross sectional contour of the groove 35. Said projection 64 and the straight edge 63 are held in firm contact with the walls of the groove and the top face of the disk 33 adjacent said groove by means resiliently pressing downwardly with a spring pressure on said scraper member 61, said means, preferably, comprising a rod-like member 65 of

resilient material, which has an upwardly extending end portion 66 mounted in an opening in the cover member 43 and which engages the top edge of the scraper member 61, as will be obvious from Fig. 5, the end of said member 65 opposite the end 66 being mounted in one of the notches or recesses 67 of an angular bracket 68 mounted in the housing 28, preferably, being secured to the vertical wall 28 thereof in fixed position. It will be obvious that the pressure exerted by the spring 65 can be varied as desired, by adjustment of the end thereof relative to the bracket 68 by placing the same in a suitable recess or notch for the pressure desired. The recesses or notches 67 are shaped so that the upward pressure exerted on the end of the spring member 65, due to the flexing thereof where the same engages the scraper 61, will hold said end in one of said notches in said bracket, as will be obvious from Figs. 2, 4 and 5.

It will be obvious from the above that the scraper member 61 will engage firmly on its bottom edge with the top face of the disk-like member 33 and that the depending projection 64 thereof will engage firmly with the walls of the groove 35 to thus remove all the material from the groove and prevent any escape thereof beyond the scraper member 61 as the disk 33 rotates in a clockwise direction, as viewed in Fig. 2. It will be noted that the scraper 61 does not extend radially of the disk, but at an oblique angle to the radius so that the material will be forced in an outward direction over the periphery of the disk, due to the movement of the disk 33 relative to the scraper. The groove 35 will have been filled fully with the finely divided material in the hopper when the same reaches the point where said groove passes under the bottom edge of the vertical wall 42 in the lower end of the hopper. As the various portions of the disk-like member in its rotation pass under the bottom edge of the wall 42, said bottom edge of said wall will remove all of the material from the top flat face of the disk-like member 33 as said face passes out of the hopper below said wall 42, except for the material contained in the annular groove 35, which material will be leveled off so that there will be a uniform amount of said material for each unit of length of the groove 35 therein as it passes out of the hopper, this condition existing until the portion of the disk containing the material in the groove reaches the scraper 61, whereupon it will be removed and discharged over the peripheral edge of the disk to drop by gravity into the housing 28.

At the point where this gravity discharge of the finely divided material from the disk takes place, the bottom wall 29 of the housing is provided with an opening 69, said housing having a tubular housing 70 depending therefrom and aligning with the opening 69. Said depending housing 70 is provided with a pair of bearing members 71, which may be of a self-lubricating character, and in which the shaft portions or pivot members 72 are rotatably mounted. Said pivot members or shaft portions 72 extend from a frame 73 of a sieve or sifter 74 of wire, or similar foraminous material. A lever 75 is fixed to one of said shaft members 72 so as to move therewith. Rotatably mounted on the lower end of said lever 75 is a wheel or roller 76, which is, preferably, provided with a resilient rim portion, or rubber tire, 77, a spring 78 extending from the axis of rotation of said wheel 76 to a bracket 79 to hold the rim of said wheel in contact with a cam member 80, which is provided with a plurality of high or raised portions 81 thereon that engage said roller or wheel 76 at the rim portion 77 thereof to oscillate said lever 75 and to thus oscillate or shake the sifter 74. The cam 80 is fixed to the shaft 18 to rotate therewith, as will be obvious from Fig. 4.

Said shaking or oscillating sieve or sifter comprises a distributing means to assure even distribution of the finely divided material over an area below said sifter or sieve. The material can be discharged into or onto any desired stationary or movable means, but if the material is being measured by means of the disk feeder so that a predetermined quantity thereof is to be evenly distributed in a substantially uniform manner through some other material, it is desirable to provide means moving at a uniform rate, such as the belt conveyor shown at 82, which is shown as being supported on rollers 83 in a conventional manner, upon which a substantially uniform layer of material is provided, to which the finely divided material fed by my improved disk feeder is supplied.

While the form of the invention shown in Figs. 1 to 6, inclusive, discloses means for feeding the finely divided material to a dry, or substantially dry, material, which also is, preferably, a finely divided material, means may be provided for feeding such a finely divided material to a liquid, in which case the feeding mechanism is, preferably, the same as previously described, except that the sifting means is omitted and instead a housing 70' is provided, as shown in Figs. 7 and 8, which is liquid tight, and is provided with a bottom wall 84, with which a discharge pipe 85 is in liquid tight connection, said pipe leading to a T 86 provided with a nozzle 86' in a liquid line 87, through which liquid flows from left to right, as shown in Fig. 7, to which the finely divided material is supplied. The finely divided material in such case is, preferably, soluble in the liquid, and in order to assure a thorough mixture of the liquid and the finely divided material, which is substantially uniform, the liquid inlet conduit 88 leading into the container 70 leads into the same substantially tangentially thereof, as will be obvious from Fig. 8, said inlet conduit 88 being connected with the liquid conduit 87 through the T 89 and suitable pipe fittings, including a valve 90 for controlling the supply of liquid to the liquid container 70'.

In order to check the rate of feed and determine whether the calibration of the dial 26 is proper, the entire apparatus may be mounted on the platform 91 of scales 92, which may be provided with the usual beam 93 having a slidably adjustable weight 94 thereon and a supporting member 96 for additional weights 97 to weigh the contents of the hopper at intervals to check the amount of material having passed therefrom through the feeding device, whereby the accuracy of the feed can be determined.

What I claim is:

1. In a device for feeding finely divided material at a controlled rate, a hopper, a disk mounted for rotation about an axis passing through its center and forming the bottom of said hopper, said disk having a plane top face except for an annular groove of uniform cross section therein concentric to said axis of rotation, said hopper having a continuous imperforate cylindrical wall portion of less diameter than the annulus of said groove contiguous to said disk, said wall portion having a continuous circular bottom edge lying

in a plane parallel to said top face and adapted to engage said top face of said disk face to face, said circular edge being eccentric to said axis so that a portion of said groove lies within said hopper and a portion of said groove lies externally of said hopper, means for pressing said bottom edge into tight engagement with said top face to prevent escape of finely divided material from said hopper except through emergence thereof in said groove under said bottom edge due to rotation of said disk, said bottom edge extending uninterruptedly across said groove to level the material in said groove to fill it to the top face of said disk and provide a uniform depth of said material in said groove as said groove emerges from said hopper, means engaging said groove externally of said hopper to remove all said material therefrom at a predetermined station during rotation of said disk, means for rotating said disk at a predetermined rate, and means for adjusting the rate of rotation of said disk to adjust the rate of feed of said finely divided material.

2. In a device for feeding finely divided material at a controlled rate, a hopper, a disk mounted for rotation about an axis passing through its center and forming the bottom of said hopper, said disk having a plane top face except for an annular groove of uniform cross section therein concentric to said axis of rotation, said hopper having a continuous imperforate cylindrical wall portion of less diameter than the annulus of said groove contiguous to said disk, said wall portion having a continuous circular bottom edge lying in a plane parallel to said top face and adapted to engage said top face of said disk face to face, said circular edge being eccentric to said axis so that a portion of said groove lies within said hopper and a portion of said groove lies externally of said hopper, means for pressing said bottom edge into tight engagement with said top face to prevent escape of finely divided material from said hopper except through emergence thereof in said groove under said bottom edge due to rotation of said disk, said bottom edge extending uninterruptedly across said groove to level the material in said groove to fill it to the top face of said disk and provide a uniform depth of said material in said groove as said groove emerges from said hopper, means engaging said groove externally of said hopper to remove all said material therefrom at a predetermined station during rotation of said disk, means for rotating said disk at a predetermined rate, and means for adjusting the rate of rotation of said disk to adjust the rate of feed of said finely divided material, comprising a movable controlling member and means for varying said rate of rotation in direct proportion to the movement of said controlling member.

3. In a device for feeding finely divided material at a controlled rate, a hopper, a disk mounted for rotation about an axis passing through its center and forming the bottom of said hopper, said disk having a plane top face except for an annular groove of uniform cross section therein concentric to said axis of rotation, said hopper having a continuous imperforate cylindrical wall portion of less diameter than the annulus of said groove contiguous to said disk, said wall portion having a continuous circular bottom edge lying in a plane parallel to said top face and adapted to engage said top face of said disk face to face, said circular edge being eccentric to said axis so that a portion of said groove lies within said hopper and a portion of said groove lies externally of said hopper, means for pressing said bottom edge into tight engagement with said top face to prevent escape of finely divided material from said hopper except through emergence thereof in said groove under said bottom edge due to rotation of said disk, said bottom edge extending uninterruptedly across said groove to level the material in said groove to fill it to the top face of said disk and provide a uniform depth of said material in said groove as said groove emerges from said hopper, a scraper externally of said hopper having a projecting portion of the cross sectional shape of said groove engaging in said groove at a predetermined station and having straight edged portions on opposite sides of said projecting portion engaging the plane face of said disk on opposite sides of said groove, resilient means holding said scraper in pressure engagement with said plane face and groove, means for rotating said disk at a predetermined rate, and means for adjusting the rate of rotation of said disk to adjust the rate of feed of said finely divided material.

4. In a device for feeding finely divided material at a controlled rate, a hopper, a disk mounted for rotation about an axis passing through its center and forming the bottom of said hopper, said disk having a plane top face except for an annular groove of uniform cross section therein concentric to said axis of rotation, said hopper having a continuous imperforate annular wall portion terminating in a continuous circular bottom edge of less diameter than the annulus of said groove and lying in a plane parallel to said top face and adapted to engage said top face of said disk face to face, said circular edge being eccentric to said axis so that a portion of said groove lies within said hopper and a portion of said groove lies externally of said hopper, flexible members engaging the plane face of said disk and rotatable with said disk within said hopper about an axis eccentric to said annular wall portion and engaging said wall portion to move across and fill said groove with said finely divided material, means for pressing said bottom edge into tight engagement with said top face to prevent escape of finely divided material from said hopper except through emergence thereof in said groove under said bottom edge due to rotation of said disk, said bottom edge extending uninterruptedly across said groove to level the material in said groove to fill it to the top face of said disk and provide a uniform depth of said material in said groove as said groove emerges from said hopper, means engaging said groove externally of said hopper to remove all said material therefrom at a predetermined station during rotation of said disk, and means for rotating said disk at a predetermined rate.

5. In a device for feeding finely divided material at a controlled rate, a hopper, a disk mounted for rotation about an axis passing through its center and forming the bottom of said hopper, said disk having a plane top face except for an annular groove of uniform cross section therein concentric to said axis of rotation, said hopper having a continuous imperforate annular wall portion terminating in a continuous circular bottom edge of less diameter than the annulus of said groove and lying in a plane parallel to said top face and adapted to engage said top face of said disk face to face, said circular edge being eccentric to said axis so that a portion of said groove lies within said

hopper and a portion of said groove lies externally of said hopper, agitating means in said hopper comprising means extending above the top of said disk and rotatable therewith, a flexible member secured to said means and having an upwardly extending portion curving upwardly and outwardly therefrom and engaging the hopper wall and having a downwardly extending portion curving downwardly and outwardly therefrom, and a stationary flexible member projecting inwardly from the hopper wall adjacent the path of said downwardly curved flexible member, means for pressing said bottom edge into tight engagement with said top face to prevent escape of finely divided material from said hopper except through emergence thereof in said groove under said bottom edge due to rotation of said disk, said bottom edge extending uninterruptedly across said groove to level the material in said groove to fill it to the top face of said disk and provide a uniform depth of said material in said groove as said groove emerges from said hopper, means engaging said groove externally of said hopper to remove all said material therefrom at a predetermined station during rotation of said disk, and means for rotating said disk at a predetermined rate.

LYNDUS E. HARPER.

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1,056,527	Foster	Mar. 18, 1913
1,151,742	Van Brunt et al.	Aug. 31, 1915
1,620,280	Newton	Mar. 8, 1927
1,751,335	Kennedy	Mar. 18, 1930
1,787,289	Thomas	Dec. 30, 1930
1,936,105	Cole	Nov. 21, 1933
1,940,138	McAdam	Dec. 19, 1933
1,947,851	Jewett	Feb. 20, 1934
2,047,203	Henson	July 14, 1936
2,116,105	Eaton	May 3, 1938
2,215,201	Vogel-Jorgensen	Sept. 17, 1940
2,322,373	Lowe	June 22, 1943
2,369,508	White	Feb. 13, 1945