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METHOD AND APPARATUS FOR DISTRIBUTING VISCOUS LIQUIDS AND HEAVY SLURRIES

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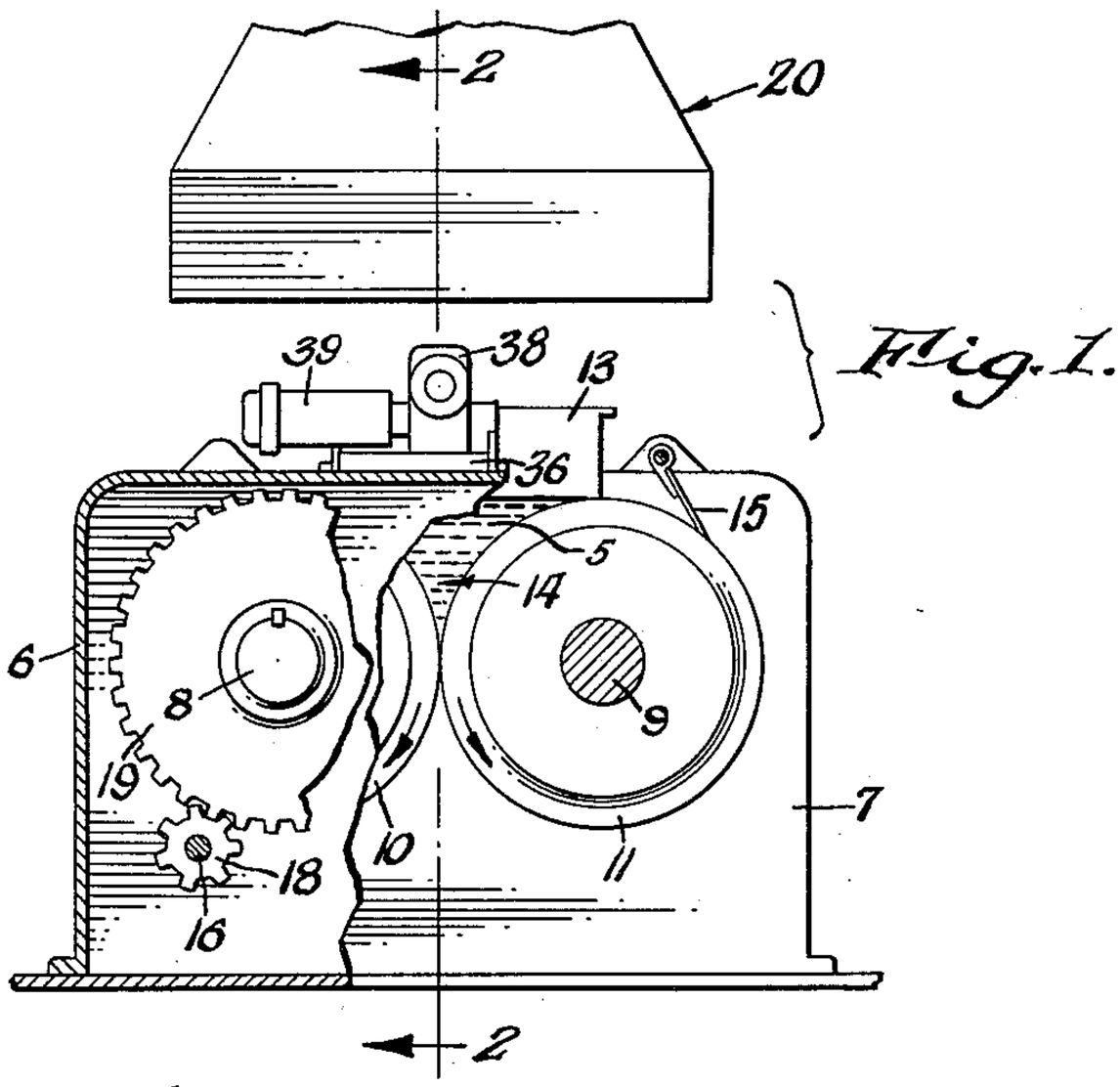

Fig. 1.

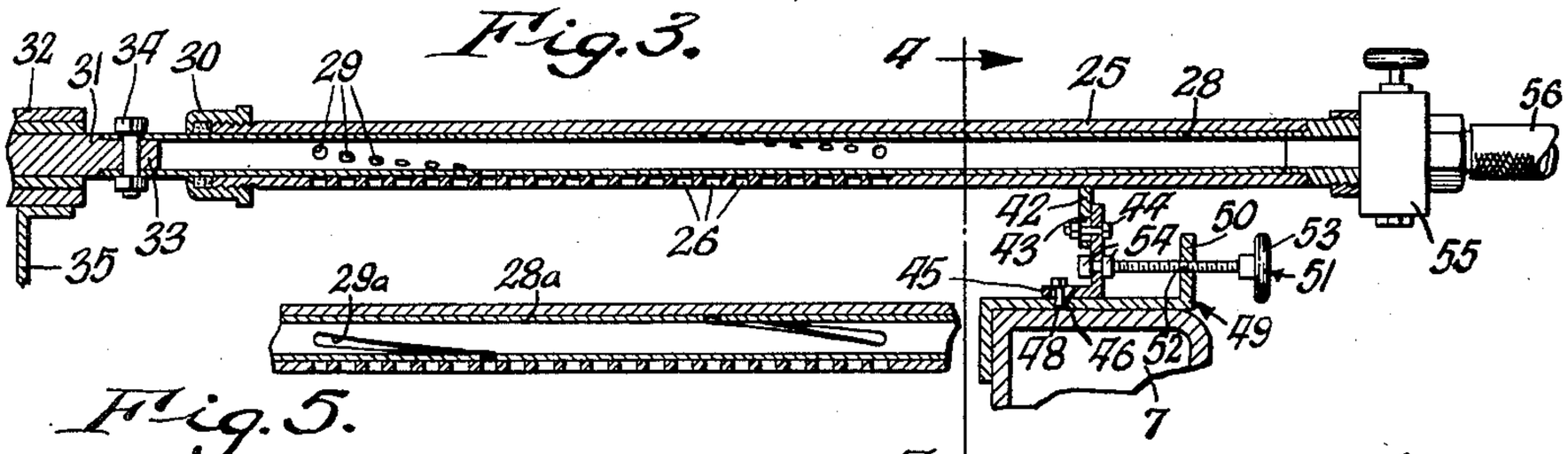

Fig. 3.

Fig. 5.

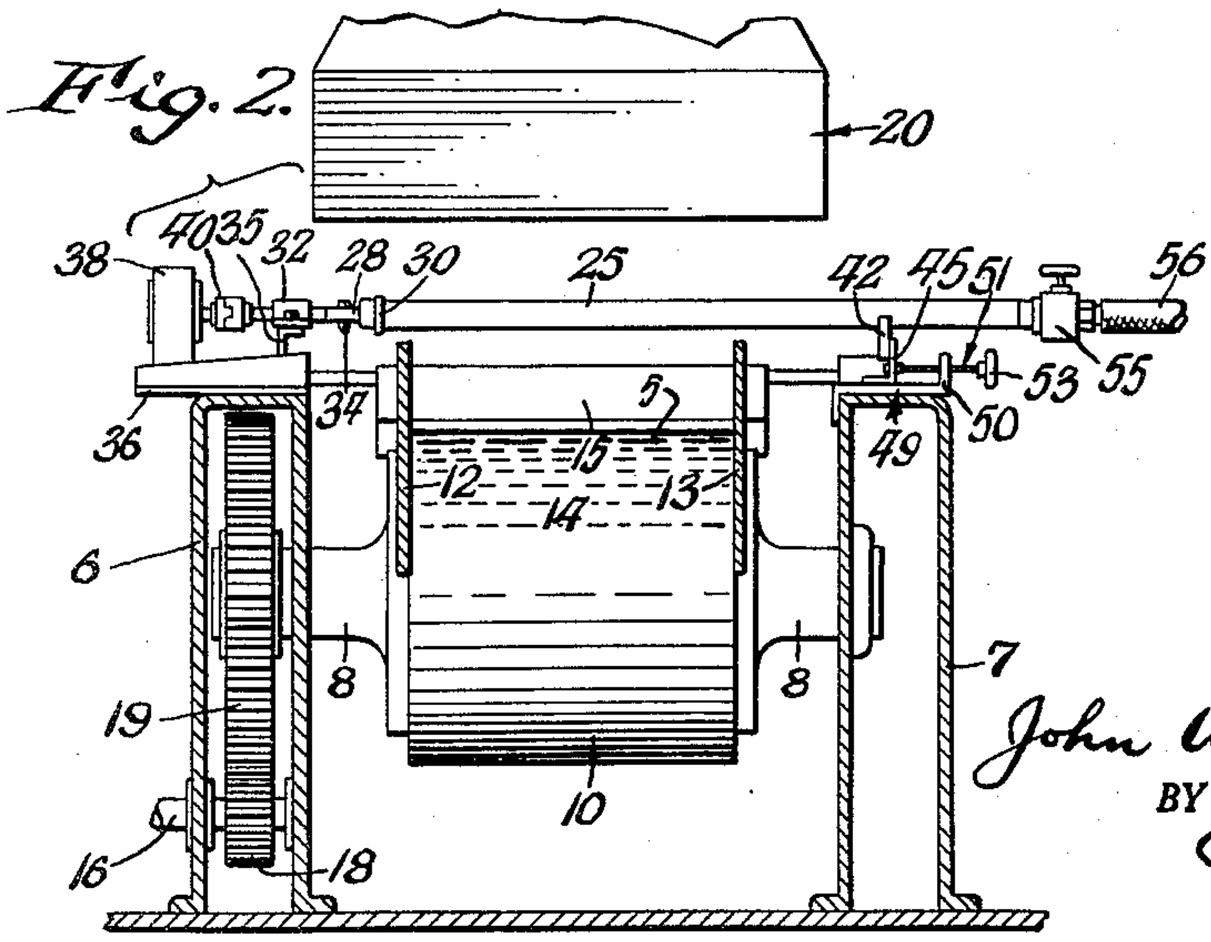

Fig. 2.

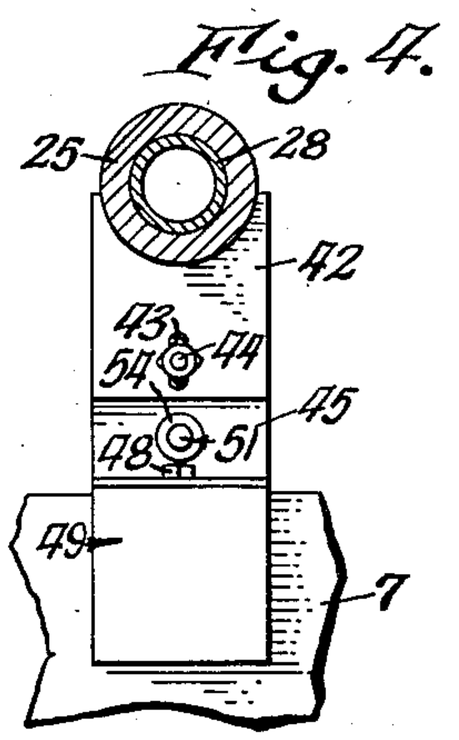

Fig. 4.

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METHOD AND APPARATUS FOR DISTRIBUTING VISCOUS LIQUIDS AND HEAVY SLURRIES

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7 Claims. (Cl. 299—106)

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This invention relates to a method and apparatus for distributing viscous liquids and heavy slurries and is more particularly shown as used in conjunction with an atmosphere double drum dryer, although the invention can be employed wherever it is desired to distribute such viscous liquids or heavy slurries uniformly over an extensive area, particularly along an extended line, such as in distributing liquid soap uniformly the full length of a flaker drum in chilling the soap, or distributing molasses uniformly into a mixer or blender or into a screw conveyer through which other materials are being moved.

In distributing a regulated amount of liquid uniformly over an extended distance a number of difficulties develop when the liquid to be distributed has a considerable viscosity or contains solids in suspension. These difficulties are even more pronounced if the liquid is to be distributed over the surface of a set of heated revolving drums as in the case of a double drum dryer and the invention will be more particularly described in conjunction with a double drum atmospheric dryer.

The liquid fed to a double drum dryer not only should be distributed as evenly as possible over the length of the drums, but has to be limited to the amount which the dryer is capable of handling. A simple perforated feed pipe or overflow trough is entirely satisfactory if the liquid has a low viscosity so that the liquid dropping into or entering the pool held between the drums immediately mixes with the liquid in the pool and establishes a uniform level of the pool and a uniform condition of the liquid contained throughout the entire length of the pool.

Reciprocating feeding devices traveling along the pool contained between the drums of an atmospheric double drum dryer have been employed, such as a reciprocating carriage or the pendulum feed pipe shown in the Lavett Patent No. 2,129,329. Such reciprocating feeding devices require a reversal of travel at opposite ends of the drums and have not been satisfactory in some instances because of the variation in the rate of travel of the feeding devices. Thus, as the reciprocating feeding device approaches each end of the pool between the drums it slows up, stops for a moment, and then increases in speed on starting the reverse stroke. The rate of feed by the reciprocating carriage for pendulum feed pipe usually is constant and hence the reduced rate of travel at the ends of the drums results in a greater amount of liquid being delivered at the ends of the drums as compared with the

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centers of the drums. If this excess feed liquid delivered at the ends of the pool between the drums mixes quickly with the liquid at the center of the pool, the operation of these reciprocating feeding devices is satisfactory. If, however, the liquid is of such viscosity that it does not quickly mix with the liquid in the pool, the liquid in the pool at the centers of the drums becomes more concentrated whereby a relatively dilute film is applied to the ends of the drums as compared with the centers thereof. This results in highly undesirable uneven drying conditions and which is especially pronounced if the feed liquid is of high viscosity or is a heavy slurry. In addition, such a reciprocating feeding device does not deposit liquid at uniform intervals except in the exact center. Away from the center intervals are alternately longer and shorter depending on the distance from the ends.

Feeding a heavy liquid or slurry through a perforated pipe or a series of small apertures of fixed dimension is not satisfactory because of frequent stoppages of these small openings thereby again resulting in non-uniformity of feed of the liquid from one end of the pool to the other as well as diminishing the rate of the feed.

Accordingly it is one of the objects of this invention to provide a method and apparatus for feeding viscous liquids and heavy slurries which will distribute the same through a large discharge opening and uniformly along an extended area regardless of the consistency or viscosity of the liquid being handled.

Another object is to provide such a method and apparatus for feeding viscous liquids and heavy slurries which will operate with such uniformity for an indefinite period of time and in particular will not clog or deliver the liquid at a diminishing rate.

Another object is to provide such a distributing feeder for viscous liquids and heavy slurries which is adjustable in its action while in operation and in particular in which the size of the large openings through which the liquid or slurry is discharged can be adjusted while the feeder is in operation.

Another object of the invention is to provide such feeder which does not require an elaborate rotary joint as has been found frequently to be a source of leakage.

Another object of the invention is to provide such a feeder which is sanitary and extremely easy to clean.

Another object is to provide such a feeder

which is simple and inexpensive in construction and is reliable in operation.

Other objects and advantages of the invention will appear from the following description and drawings in which:

Fig. 1 is an end view, partly in section, showing a conventional double drum atmospheric dryer having a hood through which the vapors are vented and equipped with a distributing feeder for viscous liquid and heavy slurries embodying the present invention.

Fig. 2 is a vertical sectional view taken generally on line 2—2, Fig. 1.

Fig. 3 is an enlarged vertical section, partly in elevation, taken through the distributing feeder embodying the present invention.

Fig. 4 is a further enlarged vertical transverse sectional view taken on line 4—4, Fig. 3.

Fig. 5 is a view similar to Fig. 3 and showing a modified form of the invention.

The invention is illustrated in conjunction with an atmospheric double drum dryer which can be of any suitable construction and is illustrated in simplified form as composed of a pair of hollow end heads 6 and 7 in which the opposite ends of the shafts 8 and 9 of the pair of drums 10 and 11 are journalled. The drums are provided with the usual end boards 12 and 13 which confine the liquid as a body or pool 5 in the trough or valley 14 between the drums, and the drums are illustrated as moving downwardly at their point of closest approach to remove the viscous liquid or heavy slurries from the body 5 as films or layers which dry or harden on the under surfaces of the drums 10 and 11 and the dried material scraped off by doctor knives 15, although it will be understood that the drums could rotate in the opposite direction, that is, upwardly at their point of closest approach in which case the doctor knives 15 would be located on the lower periphery of the drums. The drums are supplied with steam or other heating medium by any suitable means (not shown) and are rotated from a main drive shaft 16 which extends through and is journalled in the end head 6 and has fast thereto, within this end head, a pinion 18. This pinion 18 drives a large gear 19 on the shaft 8, this last gear meshing with a similar gear (not shown) on the shaft 9 so that the drums 10 and 11 are driven at the same speed. The vapors generated during drying on the drums 10 and 11 are shown as vented from an overhead hood indicated generally at 20. It will be seen that the body 5 of viscous liquids or heavy slurries is subject to continuous diminution as a function of the processing of this body and that it is desirable to distributively feed the viscous liquids and heavy slurries to this body in such manner as to insure a uniform composition thereof.

The distributing feeder forming the subject of the present invention is shown as comprising a non-rotating outer horizontal pipe 25 arranged above the body or pool 5 in the valley or trough 14 between the drums 10 and 11 and extending longitudinally thereof. This outer non-rotating horizontal pipe is provided along the lower part of its periphery with a series of openings 26 extending in a straight line longitudinally thereof for a distance equal to the length of the drums over which this series is arranged. Within this outer non-rotating pipe 25 is closely fitted an inner revolving pipe 28 provided with a serpentine series of openings 29 arranged in a helix which, in the form of the invention shown in Figs. 1–4, forms one convolution. Each of these

openings 29 is arranged to register with a corresponding opening 26 of the non-rotating outer pipe 25.

The revolving inner pipe 28 projects outwardly from the non-rotating outer pipe 25 through a stuffing box 30 on the corresponding end of the outer non-rotating pipe 25 and is secured to a drive shaft 31 journalled in a bearing 32 mounted on the corresponding end head 6 of the dryer. The connection between the inner revolving pipe 28 and the drive shaft 31 is shown as comprising a solid extension 33 of the shaft 31 fitting into the inner revolving pipe 28 and secured thereto by a cross bolt 34. The mounting for the bearing 32 is shown as comprising a bracket 35 mounted on the base 36 for a variable speed transmission 38 and motor 39, this base 36 being in turn mounted on the end head 6 of the dryer.

The drive shaft 31 is shown as connected with the variable speed transmission 38 through a flexible coupling 40 and the drive motor 39 is shown as being directly connected with the case of this variable speed transmission. It will be seen that the motor 39, through this variable drive speed transmission 38 and flexible coupling 40, rotates the shaft 31 in the bearing 32, this, in turn, rotating the inner revolving pipe 28 within the outer non-rotating pipe 25. It will further be seen that the speed of rotation of this inner revolving pipe 28 can be regulated by adjustment of the variable speed transmission 38.

The end of the non-rotating outer pipe 25 opposite from its stuffing box 30 projects from the corresponding end of the inner revolving pipe 28 and this projecting end is mounted on the end head 7 of the dryer in such manner as to provide longitudinal adjustment of this outer non-rotating pipe 25 with reference to the revolving inner pipe 28 and thereby adjust the degree of registry of the openings 29 and 26 and hence the effective size thereof. For this purpose to this projecting end of the non-rotating outer pipe 25 is welded a depending vertical cross plate or bracket 42 which is provided with vertical slots 43. Bolts 44 extend through these slots into the vertical leg of an L-shaped sliding bracket 45. The lower horizontal leg of this L-shaped sliding bracket 45 is provided with slots 46 extending lengthwise of the outer non-rotating pipe 25, and vertical stud screws 48 extend through these slots. These vertical stud screws 48 project upwardly from a base 49 mounted on the end head 7 of the dryer and the outer end of this base 49 is provided with an upstanding flange 50 which rotatably supports an adjusting screw 51. This adjusting screw 51 is mounted in a threaded hole 52 in the flange 50 so that upon turning this screw through its hand wheel 53 it is moved longitudinally. The opposite end of this screw extends through an unthreaded hole in the upstanding leg of the bracket 45 and is provided with a pair of collars 54 on opposite sides of this upstanding leg so that longitudinal movement of the screw 51 effects movement of the bracket 45 on the base 49 longitudinally of the non-rotating outer pipe 25.

The end of the outer non-rotating pipe 25 opposite from its stuffing box 30 is connected through a valve 55 with a feed line 56. Since the non-rotating outer pipe 25 is longitudinally adjustable, this feed line 56 is shown as being in the form of a flexible conduit, although it will be understood that it could be a rigid pipe with a stuffing box similar to the stuffing box 30 to

permit such longitudinal adjustment of the non-rotating outer pipe **25**.

The viscous liquid or heavy slurry to be dried is supplied under a comparatively low pressure from the feed line **56**, this slurry or liquid passing through the valve **55** into the adjacent open end of the revolving inner pipe **28**. The opposite end of this inner revolving pipe **28** is blocked by the extension **33** of the drive shaft **31** and hence this slurry or liquid can only escape through such holes **29** of the revolving inner pipe **28** which at this time are in register with the corresponding holes **26** of the non-rotating outer pipe **25**. Since only one pair of these holes **29** and **26** can be in full register at any one time it will be seen that these holes **29** and **26** of the inner revolving and outer non-rotating pipes **25** and **28** can be made comparatively large and that a full flow of feed liquid or slurry is through these registering holes. The inner revolving pipe **28** is being rotated through its connection with the drive shaft **31**, this drive shaft being driven through the flexible coupling **40**, variable speed transmission **38**, and motor **39**. As this revolving inner pipe **28** so rotates, the pair of holes **29** and **26** in full register with each other are brought out of register and the next succeeding pair of holes **29** and **26** are brought into full register. This successive registry of each of the series of holes **29** and **26** continues progressively along the full length of the series of holes whereby successive drops or amounts of the feed liquid or slurry are progressively dropped into the pool **5** of liquid contained in the trough or valley **14** between the drums **10** and **11** the full length thereof in the form of a discontinuous linear curtain of falling drops. When the last holes of the two series pass out of register with each other the first holes thereof come into register and hence the progressive discharge of successive amounts of the slurry or liquid from one end of the space or valley between the drums **10** and **11** is repeated as long as the inner revolving pipe **28** is rotated.

The effective size of the openings **29**, **26** can readily be adjusted in accordance with the amount of solids in the slurry or the viscosity of the liquid. Such adjustment is also desirable if the head on the feed liquid varies as when the liquid is supplied by gravity. To effect such adjustment all that is required is to turn the hand screw **51** in a corresponding direction. Such turning moves this hand screw longitudinally relatively to the base **49** and accordingly moves the sliding L-shaped bracket **45** in a corresponding direction. This, through the depending plate or bracket **42** secured to the outer non-rotating pipe **25**, adjusts the outer non-rotating pipe **25** in a corresponding direction. Accordingly the openings **29** and **26** can be adjusted to come into full register as the inner revolving pipe **28** rotates relative to the outer non-rotating pipe **25**, or they can be adjusted to come into register in any desired degree.

Intervals between discharge through each of the openings **26** of the outer non-rotating pipe **25** can be regulated by control of the speed at which the inner revolving pipe **28** revolves. This is, of course, effected through the variable speed transmission **38**. This inner revolving pipe **28** can be provided with openings in more than one spiral if necessary to obtain discharge at more than one point at the same time. This inner pipe can also, of course, be made hollow over its entire length to permit continuous circulation of

the feed liquid through this pipe. In such event, instead of the stub shaft **31** and flexible coupling **40** a suitable gear would be keyed to the inner pipe **28** and driven from the variable speed transmission **38**.

As indicated, the distributing feeder is particularly applicable to handling heavy liquids and slurries. Excellent results have been obtained with starch slurries with an apparent viscosity of 500–9750 centipoises with pressures of only 1–10 pounds per square inch, revolving the inner pipe **28** at from 20 to 40 revolutions per minute. It has also been found that the heavier the slurry or the greater the viscosity of the liquid, the wider the range over which the rate of discharge can be varied. When feeding starch or flour slurries to a double drum dryer, the present distributing feeder is of particular benefit because the starch gelatinizes in contact with the hot drums and forms a heavy paste which does not mix readily with the fresh feed slurry. Accordingly, with such material exact uniformity and feeding at uniform intervals is particularly essential. It will be understood that one distributing feeder can be mounted above the center of the valley or trough **14** between the drums **10** and **11**, as above described, or that two such distributing feeders can be employed, one above the top of each of the drums **10** and **11**.

It will also be seen that instead of providing the non-rotating outer pipe **25** and the inner revolving pipe **28** with a series of holes, the revolving pipe can be provided with a helical slot although in this case the adjustability of the effective size of the discharge opening would be lost. Such a modification of the invention is illustrated in Fig. 5 in which the inner revolving pipe **28***a* is shown as provided with a helical slot **29***a* instead of the helical series of openings **29**. It will also be understood that the inner rotating pipe **28** could be made stationary with a longitudinal series of openings in the lowest part of its periphery and that the outer pipe **25** could be made to revolve with a helical slot or a series of openings arranged in helix.

From the foregoing it will be seen that the present invention provides a method and apparatus for feeding viscous liquids and heavy slurries which is of extremely simple and inexpensive operation and construction and which is, in effect, provided with a large through opening which travels lengthwise of the horizontal pipes so as to feed such heavy liquids and slurries with a high degree of uniformity over an extended area. It will also been seen that the feeder can be readily adjusted as to the effective size of its discharge openings to suit the viscosity or head of the feed liquid and can also be readily regulated to control the intervals between the discharge of the liquid at each point along the feeder.

I claim:

1. A distributing feeder for viscous liquids and heavy slurries, comprising a pair of generally horizontal pipes revolvably fitted one within the other and each having an end projecting beyond the other pipe, means non-rotatably supporting one of said pipes and connected to the projecting end thereof, said one of said pipes having the lower part of its periphery provided with at least one opening extending a substantial distance along the length thereof and the other of said pipes being provided with at least one opening also extending a substantial distance along the length thereof and arranged to register

with a substantial extent of the length of said first opening, a stuffing box secured to the end of said outer of said pipes from which the inner of said pipes projects and surrounding said projecting end of said inner of said pipes, a continuously rotating driver connected to said projecting end of said other of said pipes and arranged to rotate continuously said other of said pipes relative to said one of said pipes, and means connected to said projecting end of said one of said pipes and arranged to supply the material to be distributed to the inner of said pipes, said opening in said other of said pipes being of serpentine form whereby limited portions of said openings are in register at any one time to provide a through opening traveling lengthwise of said pipes as said pipes rotate relative to each other.

2. A distributing feeder for viscous liquids and heavy slurries, comprising a pair of generally horizontal pipes revolvably fitted one within the other, and each having an end projecting beyond the other pipe, means non-rotatably supporting the outer pipe and connected to the projecting end thereof, said outer pipe having the lower part of its periphery provided with at least one opening extending a substantial distance along the length thereof and the inner pipe being provided with at least one opening also extending a substantial distance along the length thereof and arranged to register with a substantial extent of the length of said first opening, a stuffing box secured to the end of said outer pipe from which the inner pipe projects and surrounding said projecting end of said inner pipe, a bearing supporting the projecting end of said inner pipe, a continuously rotating driver connected to the projecting end of said inner pipe and arranged to rotate continuously said inner pipe, and means connected to said projecting end of said outer pipe and arranged to supply the material to be distributed to the interior of the inner pipe, said opening in said inner pipe being of serpentine form whereby limited portions of said openings are in register at any one time to provide a through opening traveling lengthwise of said pipes as said inner pipe rotates.

3. A distributing feeder for viscous liquids and heavy slurries, comprising a pair of generally horizontal pipes revolvably fitted one within the other, an adjusting mounting for one of said pipes and permitting it to be adjusted lengthwise of its axis but holding it against rotation, a journal mounting for the other of said pipes and permitting its rotation but holding it against lengthwise movement, said one of said pipes having the lower part of its periphery provided with a series of openings extending a substantial distance along the length thereof and said other of said pipes being provided with a series of openings also extending a substantial distance along the length thereof and having its openings arranged to register with the openings of said first series as said pipes rotate relative to each other, the openings of said two series being of such size and arrangement that adjustment of the longitudinal position of said one of said pipes adjusts the effective size of both series of openings, a continuously rotating driver, means connecting said continuously rotating driver with said other of said pipes to rotate continuously said other of said pipes relative to said one of said pipes and means arranged to supply the material to be distributed to the interior of the inner of said pipes, said series of openings in said other of said pipes being of serpentine form whereby a limited number of the two series are in register at any one time to provide a limited number of through openings traveling lengthwise of the pipes as the pipes rotate relative to each other.

4. A distributing feeder for viscous liquids and heavy slurries, comprising a pair of generally horizontal pipes revolvably fitted one within the other, an adjusting mounting for one of said pipes and permitting it to be adjusted lengthwise of its axis but holding it against rotation, a journal mounting for the other of said pipes and permitting its rotation but holding it against lengthwise movement, said one of said pipes having the lower part of its periphery provided with a series of openings extending a substantial distance along the length thereof and said other of said pipes being provided with a series of openings also extending a substantial distance along the length thereof and having its openings arranged to register with the openings of said first series as said pipes rotate relative to each other, the openings of said two series being of such size and arrangement that adjustment of the longitudinal position of said one of said pipes adjusts the effective size of both series of openings, a continuously rotating driver, means connecting said continuously rotating driver with said other of said pipes to rotate continuously said other of said pipes relative to said one of said pipes, means connected with said one of said pipes and arranged to supply the material to be distributed to the interior of the inner of said pipes, and a stuffing box secured to one end of the outer of said pipes and surrounding the corresponding part of the inner of said pipes, said series of openings in said other of said pipes being of serpentine form whereby a limited number of the two series are in register at any one time to provide a limited number of through openings traveling lengthwise of the pipes as the pipes rotate relative to each other.

5. A distributing feeder for viscous liquids and heavy slurries, comprising a pair of generally horizontal pipes revolvably fitted one within the other and each having an end projecting beyond the other pipe, an adjusting mounting for the projecting end of one of said pipes and permitting it to be adjusted lengthwise of its axis but holding it against rotation, a journal mounting for the projecting end of the other of said pipes and permitting its rotation but holding it against lengthwise movement, said one of said pipes having the lower part of its periphery provided with a series of openings extending a substantial distance along the length thereof and said other of said pipes being provided with a series of openings also extending a substantial distance along the length thereof and having its openings arranged to register with the openings of said first series as the pipes rotate relative to each other, the openings of said two series being of such size and arrangement that adjustment of the longitudinal position of said one of said pipes adjusts the effective size of both series of openings, a stuffing box secured to the end of the outer of said pipes from which the inner of said pipes projects and surrounding said projecting end of said inner of said pipes, a continuously rotating driver connected to the projecting end of said other of said pipes and arranged to rotate continuously said other of said pipes relative to said one of said pipes, and a flexible conduit connected to said projecting end of said one of said

pipes and arranged to supply the material to be distributed to said inner of said pipes, said series of openings in said other of said pipes being of serpentine form whereby a limited number of the openings of the two series are in register at any one time to provide a limited number of through openings traveling lengthwise of the pipes as the pipes rotate relative to each other.

6. In the processing of a body of viscous liquids and heavy slurries which body has an extensive upper surface and which processing involves the continuous diminution of said body, the method of feeding said viscous liquids and heavy slurries to said body to insure substantially uniform composition of all parts of said body, which comprises continuously releasing from a substantial distance above said surface and at substantially uniform time intervals a succession of substantially uniformly spaced separate drops of substantially uniform size along a horizontally extending line to provide a discontinuous linear curtain of drops falling by gravity into said body linearly along said upper surface thereof, and regularly repeating said last step to feed said viscous liquids and heavy slurries at a rate corresponding to the continuous diminution of said body in the processing thereof.

7. The process as set forth in claim 6 wherein said amounts are released from a supply maintained under pressure.

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