Oct. 11, 1955 F. E. STIRN ET AL 2,720,341

FLEXIBLE NON-BRIDGING POWDER HOPPER

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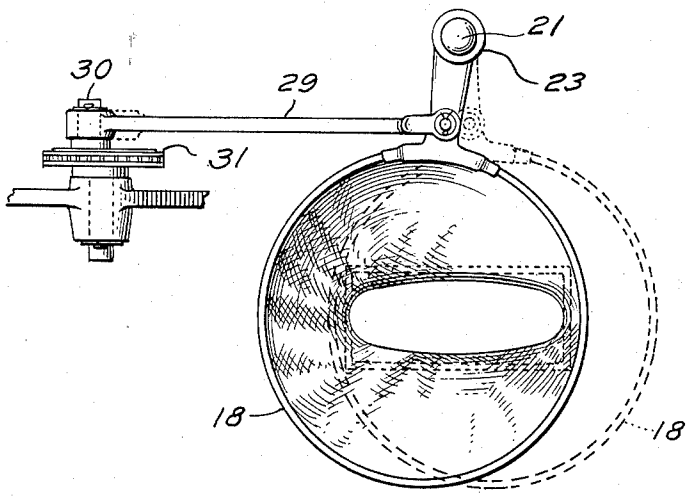


Fig. 1.

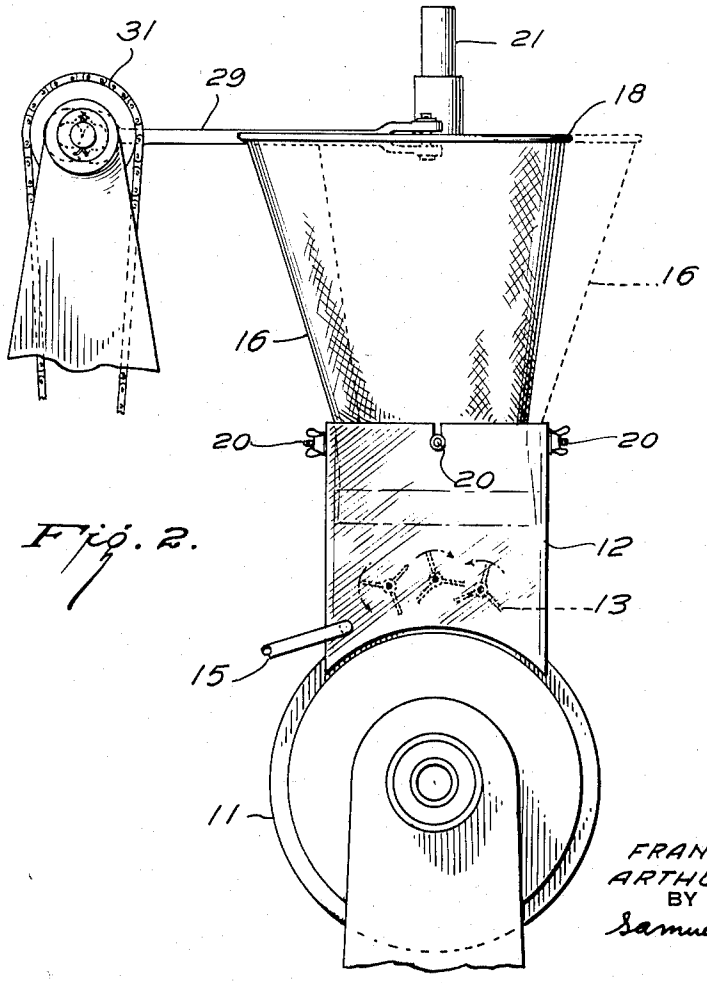


Fig. 2.

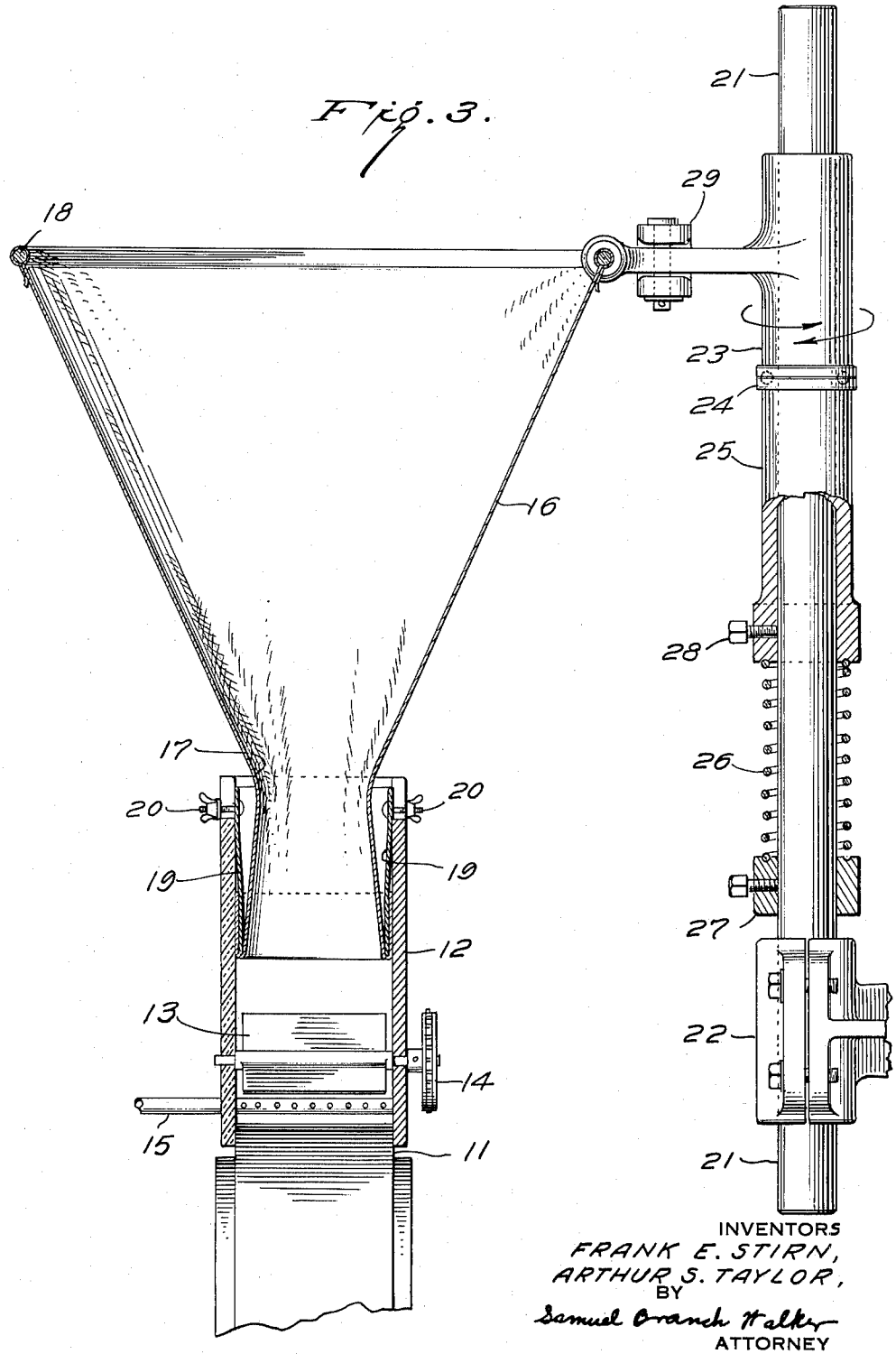
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Fig. 3.



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FLEXIBLE NON-BRIDGING POWDER HOPPER

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6 Claims. (Cl. 222—195)

This invention relates to improvements in a method and mechanism for feeding a powder to a measuring system.

It is an object of this invention to provide a method and a machine whereby a powder may be filled to a hopper, and from the hopper into a charge measuring device whereby the supply of powder is smooth, uniform, and continuous, and whereby the powder will not unduly compact, bulk, bridge, or feed unevenly into the powder measuring device.

The hopper is described and illustrated in particular in connection with a rotatable measuring roll which is mounted for rotation. The powder hopper is adjacent thereto and rests upon the roll. The roll has measuring cavities which are filled with the powder as the roll rotates under the hopper. The cavities are discharged at a suitable position of the roll's travel and again refilled on subsequent revolutions.

In the past, much trouble has been had with the powder tending to pack to the point where it jammed the machine or ceased to feed evenly, or bridged and bulked, whereby the powder was not fed at all or in uneven spurts. The bridging of powders in feed hoppers is well known. Grain storage bins, gravel storage bins, coal hoppers and many other devices utilize a scheme whereby a particulate aggregate is required to flow from a larger to a smaller opening uniformly and smoothly. Particularly when the material is slightly sticky or wet, the flowing particles tend to stick to each other and form a bridge so that while the hopper appears full, there is no discharge from the lower end. Agitators or vibrators of many descriptions have long been used with varying degrees of success. For fine powders, none of these have been uniformly successful. Certain powders may be fed by certain systems, but in the past no system has been satisfactory for powders in general.

We have found that by making the converging portion of the powder feed system of a flexible, foraminous material, it is possible to prevent this bridging. An arch bridge must have a support, and if the support is removed the bridge breaks. It is far easier to break the arch of powder by only providing an un-permanent abutment than by attempting to insure that the arch is broken by mechanical means. It is desirable that the cone be foraminous when used in conjunction with a measuring roll, particularly if the measuring roll uses suction to compact the powder into its charge chambers. Otherwise there is a tendency for the fluidizing gases to be removed and cause the powder to unduly compact.

We have found that if the foraminous flexible cone is caused to oscillate or periodically shift slightly by mechanical means, the powder contained therein will uniformly and smoothly flow to the lower end without difficulty.

By the use of our device, gummy and sticky powders which can be fed by no other means smoothly and uniformly flow to the rotatable measuring roll.

The entire feed assembly may, of course, be surrounded by an external shield so that an inert or dry atmosphere may be used when such appears desirable. We prefer to operate in an air-conditioned room.

These and many other objects and advantages of our invention will more clearly appear from a study of the specification and accompanying drawings.

In the drawings:

Figure 1 is a plan view looking down on the powder feed system.

Figure 2 is a front view showing the powder feed system in conjunction with a rotatable measuring roll.

Figure 3 is a side view of a particular support means and oscillating mechanism, as well as a cross section of the powder system. The powder fills the entire assembly but is not shown throughout as it would obscure the mechanism.

As shown in Figure 3, a rotatable powder measuring roll **11** has mounted thereon a feed hopper **12**. It is advantageous that the hopper be universally mounted so that any variations in the roll may be compensated by slight movements in the hopper so that a smooth and non-leaking seal is formed between the hopper and the roll. The feed hopper itself should desirably have substantially parallel walls or walls which are slightly converging so that as the powder feeds downward, it is in no wise compacted by the side walls, which would tend to cause the powders to bridge or block.

Rotating in the feed hopper are agitators **13**. One or more agitators may be used, and the agitators may consist of loops of wire attached to a shaft, or blades as shown. The shaft may be rotated by an agitator drive means **14**. If more than one agitator is used, the agitators may be placed together so that they rotate through the paths of travel of each other like gears, whereby the powder is more thoroughly kept in motion.

If the powder measuring roll has a vacuum system for compacting the powder into its charge chambers as is usually desirable, where accuracy is needed, there is a tendency for the powders to be compacted by the drawing off the boundary layer of gas on each of the particles which tends to keep the powder fluidized. A gas injector **15** may be provided which may consist of a tube having small holes drilled therein running through one side of the feed hopper. This gas injector may have air, preferably dried, or an inert gas, fed thereinto to assist in keeping the powders fluidized. Several gas injectors may be used for large hoppers or particularly recalcitrant powders.

Above the agitators there is fastened the lower end of a flexible, foraminous, throated, double cone **16**. Ordinary woven fabrics are usually satisfactory for this cone and may be easily fastened and assembled. A good grade of sail cloth or canvas will serve for most pharmaceutical powders. Felts, leather, plastics, etc. may be used. If sufficient injected gas is used, it need not be porous.

This double cone is arranged so that the lower end is fastened into the feed hopper slightly above the agitators, tapers to a narrowing throat **17** and from the narrowing throat **17** again flares out to a support frame **18**. Some powders will feed satisfactorily without the use of agitators but for most pharmaceutical filling, the presence of the agitators assists in assuring satisfactory fills.

To permit observation of the flow of powder through this portion of the device, it is desirable, but not necessary, that the feed hopper **12** be constructed with at least part of the walls, preferably the face, of transparent materials. Glass or a transparent resin, such as for example many of the polyvinylacrylates, or polystyrenes, is very useful. The non-breakable resins are in general safer as there is then no chance of broken portions of the feed hopper being present in the finished product. Machineable resins are particularly easy to use in construction.

The lower end of the cone may be fastened in the feed hopper by various means. By having the double cone sufficiently long that it may be turned up over the outside of a retaining sleeve **19**, a smooth continuous inner wall may be readily provided. The lower end of the cone may be attached to the outside of the retaining sleeve by an adhesive, or by clips, clamps, etc. It is normally unnecessary to have a retaining shoulder against which the sleeve can bind and hold the lower end of the double cone. The sleeve may be positioned by fasteners **20** which may be of the wing-nut variety for aid in rapid dis-assembly. From the throat to the bottom of this sleeve, the double cone should expand so that during motion of the cone as later explained, the throat or lower cone is not substantially supported by the sleeve throughout a major portion of its length and thereby a solid base for a bridge is avoided.

From the throat **17** to the supporting frame **18**, the double cone flares in conical shape as shown in Figures 2 and 3. A straight-sided cone is illustrated and the hopper portion of the cone is shown as of rounded configuration. A rectangular, elliptical, or other shape cone may be used, but for convenience a rounded cone is particularly practical because the stresses, due to its rounded shape, are more nearly balanced. If the lower end of the cone is somewhat elliptical with an elliptical throat as shown, the slight deviations from a circular cross-section will aid in preventing the powder from binding. The double cone may be sewn to the support frame **18** as shown, or otherwise fastened thereto.

The support frame is in turn shiftably mounted. The mechanism for permitting this frame to be moved, and its path, are not critical. Various support means may be used. The path may be straight, circular, zig-zag, or of other shape. As illustrated in Figure 3, the support frame is journalled upon a stationary rod **21** which is attached to the frame of the machine **22**. The journal **23** rotates freely on the rod **21** and may have a ball bearing **24** as a thrust bearing. This thrust bearing bears on a stationary collar **25** which is in turn urged upward by a spring **26**, the lower end of which rests on a retaining collar **27**. By adjusting the position of the retaining collar **27**, the upward spring tension of the support frame **18** on the cone may be adjusted.

In operation, the frame **18** may be either resiliently urged upward or positioned by locking the set screw **28** so as to fasten the stationary collar at a certain elevation whereby the frame is permitted to shift in a horizontal plane.

With some powders, it is found that by not having the cone under constant tension and permitting wrinkles to form in it, a more efficient feed is obtained than if the frame is constantly urged upward by the tension of the spring **26**. The particular choice of operation depends upon the powder being used and other operating conditions. The intra-convertibility from one system to another is a particularly advantageous feature of this phase of our invention.

The frame is caused to move by an oscillating link **29**. No particular type of motion is needed on this oscillating link and a slot or lost motion somewhere in the link system so that a jarring, uneven, irregular motion is imparted, is more desirable than a smooth symmetrical motion for this link. As shown in Figure 1, this link **29** may be attached to a crankshaft **30** driven by a sprocket **31**. This crankshaft may be fastened to any part of the machine which is in motion. By the use of loosely fitting crankshafts and bearings, the most desirable irregular motion is imparted. By the term oscillating motion, we do not necessarily mean a smooth reciprocating motion, as any type of motion of an irregular nature is satisfactory.

We have found that parallel links or other forms of support may be used rather than the particular form illustrated. The form illustrated is particularly simple and convenient.

In operation, in the pharmaceutical industry, for filling small containers or capsules from a rotatable measuring roll, we have found that a motion of a couple of inches in each direction for the frame is sufficient to insure complete freedom from binding.

Inasmuch as the various powders to be used each possess their own physical characteristics, each of them will exhibit certain peculiarities in its feed which may be compensated by adjusting the rate of oscillation, the distance of oscillation, or the amount of jarring, or the tension on the cone, the velocity of fluidizing air flow in the injector **15**, the speed of the agitators, etc. For a vitaminaceous powder, we have found that an oscillation of several times per minute is completely satisfactory. Other equivalents and variations in the machine will suggest themselves to those skilled in the art.

Our invention is not the particular embodiment illustrated in the drawings, but is as defined in the appended claims.

As our invention, we claim:

1. In a powder feed system for a rotatable measuring roll, a powder hopper with parallel to slightly downwardly divergent sides, rotatable agitators therein, a gas injector near the bottom thereof, a flexible, foraminous, throated double cone above said hopper and feeding thereinto, said throated double cone comprising from bottom to top first a converging portion then a diverging portion, each portion possessing the general shape of a frustum of a cone, a retaining sleeve outside of the lower portion of the cone, fastening means to attach the lower end of the cone outside of and to the outside surfaces of the sleeve, a shiftably mounted frame for the upper end of the cone, support means therefor, an oscillating link attached to said frame, and an oscillating means attached to said link, whereby a powder feeding through the system converges only in the upper portion of said double cone and there are no firm supports for a powder bridge.

2. In a powder feed system, a powder hopper, a flexible, freely-hanging, foraminous, throated double cone above said hopper and feeding thereinto, said throated double cone comprising from bottom to top first a converging portion then a coaxial diverging portion, each portion possessing the general shape of a frustum of a cone, shiftable support means therefor, and an oscillating means which shifts said support means, whereby a powder feeding through the system converges only in the upper portion of said double cone and there are no firm supports for a powder bridge.

3. In a powder feed system, a powder hopper, powder agitating means therein, a flexible, throated double cone above said hopper and feeding thereinto, said throated double cone comprising from bottom to top first a converging portion then a diverging portion, each portion possessing the general shape of a frustum of a cone, a retaining sleeve for the lower end of said cone, fastening means for attaching the cone to the sleeve, said retaining sleeve and fastening means being free from projections into the path of powder flow, supporting means for the upper end of said cone, and oscillating means whereby said supporting means is caused to oscillate, whereby a powder feeding through the system converges only in the upper portion of said double cone and there are no firm supports for a powder bridge.

4. In a powder feed system for a rotatable measuring roll, a powder hopper, mechanical agitating means and fluidizing gas injecting means in said hopper, a flexible, freely-hanging, throated double cone above said hopper and feeding thereinto, said throated double cone comprising from bottom to top first a converging then a diverging portion, each portion possessing the general shape of a frustum of a cone, fastening means to attach the lower end of said double cone interiorly of said hopper, support means for the upper end of said cone, and oscillating means which shifts said support means.

5. In a powder feed system for a rotatable measuring

roll, a powder hopper, fluidizing gas injecting means in said hopper, a flexible, freely-hanging, throated double cone above said hopper and feeding thereinto said throated double cone comprising from bottom to top first a converging then a diverging portion, each portion possessing the general shape of a frustum of a cone, fastening means to attach the lower end of said double cone interiorly of said hopper, support means for the upper end of said cone, and oscillating means which shifts said support means.

6. In a powder feed system for a rotatable measuring roll, a powder hopper, mechanical agitating means in said hopper, a flexible, freely-hanging, throated double cone comprising from bottom to top first a converging then a diverging portion, each portion possessing the general shape of a frustum of a cone, fastening means to attach

the lower end of said double cone interiorly of said hopper, support means for the upper end of said cone, and oscillating means which shifts said support means.

References Cited in the file of this patent

UNITED STATES PATENTS

386,253	Marcus et al.	July 17, 1888
1,197,821	Hamachek	Sept. 12, 1916
1,321,262	Townsend	Nov. 11, 1919
1,487,058	Gwinn	Mar. 18, 1924
1,570,795	Tainton	Jan. 26, 1926
2,116,105	Eaton	May 3, 1938
2,164,483	Watson et al.	July 4, 1939
2,260,926	Wright	Oct. 28, 1941
2,416,099	Joslyn	Feb. 18, 1947