Oct. 20, 1964 W. BAKKER 3,153,498

VALVE MECHANISM WITH ACTUATOR

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fig. 1

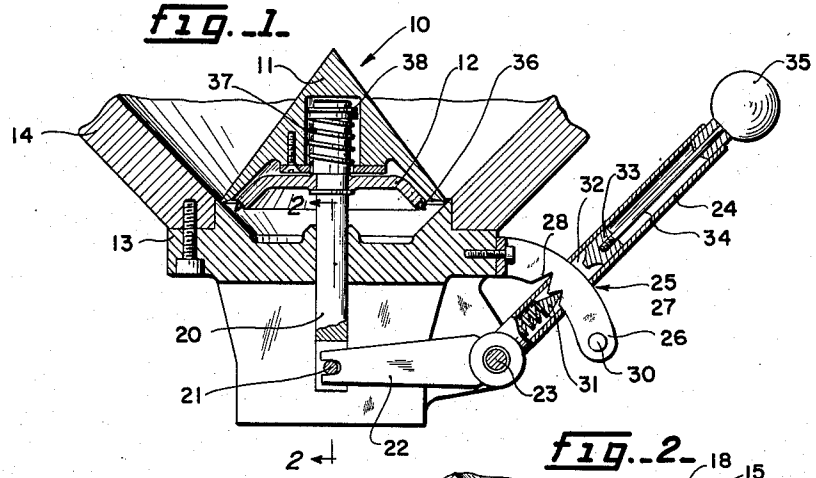


fig. 2

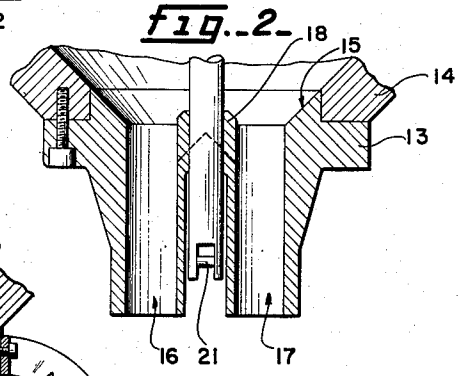


fig. 3

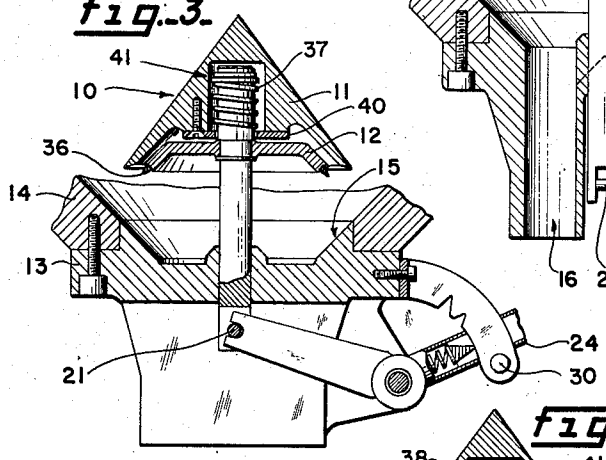
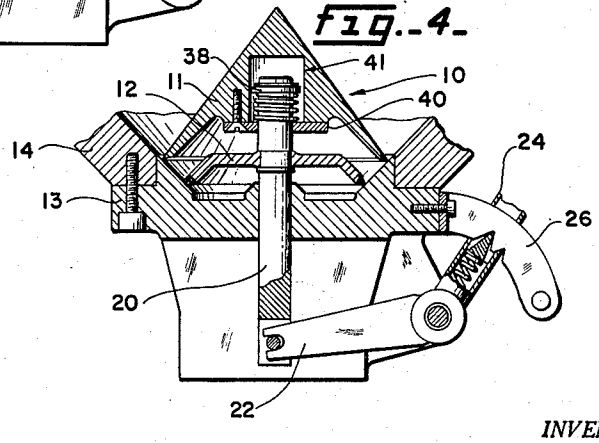


fig. 4



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VALVE MECHANISM WITH ACTUATOR

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The present invention relates generally to a valve mechanism for controlling the flow of granular material and more particularly to a bi-element valve mechanism for successively discontinuing the flow of material through a confined passageway and sealing this passageway in an air-tight manner.

It is known, of course, to provide a valve mechanism for controlling the flow of granular material such as thermoplastic polymer chips from a supply hopper to a melt spinning apparatus used for producing synthetic yarns or threads. Although some of these mechanisms are bi-element, the operating techniques are completely different and the elements in fact open or close alternately rather than successively. This operation permits feeding of a measured quantity of chips (or granules) into the spinning apparatus (the quantity per charge depending of course on the period between alternation of elements) but does not provide adequate sealing or even precise control of granular feed if chips are lodged between the valve element and the seat therefor. Moreover, the period of alternation between elements is extremely critical and this valve mechanism is practically ineffective for precisely controlling the feed of small quantities.

This invention pertains especially to valve mechanisms vertically mounted underneath a car for transporting granular material, or attached to storage bunkers for drying or otherwise conditioning chips. Although the granules may be of any type, e.g. chips obtained from synthetic polymers, grains of corn, nuts, beans, etc., the valve mechanism should permit random discharge under precise control and should also provide an efficient air seal when placed in a closed or locked condition. Further, rapid performance of these functions is extremely important, especially when controlling the flow of polymer chips. The known valve mechanisms have proved unsuitable for this and other applications, primarily because the lodging of granules between the valve element and seat prevents either precise flow cutoff or effective sealing.

An object of the present invention is to provide a valve mechanism not having the disadvantages enumerated hereinabove.

Another object of this invention is to provide a bi-element valve mechanism functioning both to precisely control the flow of granular material through a confined passageway and to effectively seal this passageway when placed in a non-feeding position.

A further object of the present invention is to provide a bi-element valve mechanism which is both simple in operation and sturdy of construction, but which is of economical manufacture.

Still another object of this invention is to provide a bi-element valve mechanism of high speed operation which may be used for controlling the flow of granular material such as thermoplastic polymer chips in random quantities, and which may be manipulated by persons having a minimum of training or aptitude.

The present invention contemplates modification of known valve mechanisms to the extent that a single operating linkage is provided for substantially simultaneously opening and/or closing both the flow-controlling and the sealing elements. This linkage operates in such a manner that the sealing element is positioned nearest the discharge opening of a confined passageway and is

closed last. Prior closure of the flow control element permits evacuation of the sealing element valve seat so that a gas-tight fit may be assured. Opening of these elements of course involves movement in the reverse order. One of the advantages to this apparatus is that first closure of the flow control element stops the flow of granules with the result that the sealing element contacts a smooth seat.

Although the two valve elements of course could each be attached to separate valve stems, actuated by one and the same operating system through suitable toggle linkage, this construction is objectionable in that it is cumbersome and requires much space. Moreover, failure of one element is possible with the result that the entire mechanism will function improperly. Consequently, it is preferred, according to the invention, that the two valve elements be mounted for relative movement on one and the same vertical valve stem, for example with the lower valve element fixed and the upper valve element spring suspended. With this arrangement, the operating linkage may be of simple construction since only one valve stem need be moved. Inasmuch as the valve elements are spring-coupled, they automatically assume correct relative positions on respective valve seats after being closed. An additional advantage is that the valve elements can be mounted very near to each other and therefore occupy very little space.

An obvious application of known valve mechanisms to the problems here under consideration would be to provide a separate valve seat for each element and to utilize a planar surface for each seat. A disadvantage to this, however, is that the two seats must be machined separately. An additional disadvantage of planar or flat seats consists in that granules or dust may remain thereon after discontinuation of feed to destroy the sealing action. To avoid these drawbacks, this invention contemplates seating both valve elements against a single conical plane. The entire conical surface may be machined in one operation. Moreover, the vertical angle of the conical plane may be selected to avoid retention of granules or dust particles thereon after feed is discontinued prior to sealing.

The valve sealing element preferably is provided with a rim of elastic material, for example, rubber. This not only provides a very good seal, but at the same time facilitates sealing under a constant pressure. Moreover, the elastic material of the rim permits additional flexibility of the system, as a result of which even with a somewhat less accurate closed position it is still possible to obtain a satisfactory sealing effect.

To obtain a reliable valve mechanism capable of rapid operation, it has been found that a snap-latch should be provided for releasably locking the elements in at least two positions, that is, with one or both in a closed condition. A spring-detent, quick-release latch arrangement is illustrated herein. With a manually controlled operating system, the device need only be moved successively into the two positions, in which it snaps automatically, and a proper sealing effect is obtained.

Other objects and advantages will become apparent upon study of the following description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 represents a longitudinal section of the valve mechanism in the first of two locked positions, or with the feed control valve element closed for evacuation of the feeding passageway;

FIGURE 2 is a section along the line II—II in FIGURE 1, showing in detail the granule discharge conduits; and

FIGURE 3 and FIGURE 4 represent longitudinal sectional views similar to FIGURE 1, but with the valve

mechanism completely open and completely closed (both elements seated), respectively.

With attention now directed to the drawings, wherein like reference numerals are used to indicate like parts in all the views, the bielement valve mechanism of this invention is indicated generally at 10, and comprises, inter alia, flow control element 11 and sealing element 12. This mechanism is mounted for movement above a bottom plate 13 attached to chip supply hopper 14. This hopper of course may be of the conventional type used for storing or conditioning thermoplastic granular material prior to melt spinning of the same into threads or yarn, or it may be of the type such as used in transporting various granular materials from one location to another. Since this invention resides in the valve mechanism and the cooperating valve seating surface 15 of bottom plate 13, only a portion of the storage or transport hopper 14 has been illustrated. The bottom plate may be removably attached to the hopper by any suitable means, such as the bolts shown.

Bottom plate 13 is provided with two discharge openings 16 and 17 (see FIGURE 2) separated by a bridge 18. A suitable bore is drilled centrally of bridge 18 to permit passage of valve stem 20, which reciprocates vertically therethrough. The valve stem 20 actuates both feed control element 11 and sealing element 12, as will be explained hereinafter. To provide the requisite vertical reciprocation, the lower end of stem 20 is fork-shaped to accommodate a pin 21 which engages with a second fork-shaped member provided at the unsupported end of a lever 22 rotatably secured around the shaft 23. This shaft is rigidly attached to extensions of the bottom plate 13, as shown in the drawings.

Lever 22 can be oscillated about shaft 23 by a handle consisting of a tube 24 provided with lateral openings 25, which openings slidably receive a quadrant 26 attached to the bottom plate 13, as by the bolt shown. The lever 22 is formed integral with or in some suitable manner attached to tube 24 for movement therewith. Quadrant 26 is provided with two notches 27 and 28 and a stop 30 to limit oscillation of the tube and lever. A wedge 31 is mounted within the lower end of tube 24 and is urged into releasable engagement with the notches by spring pressure, as shown. Other means, such as a spring-ball and detent mechanism, of course could be provided if a less positive locking action were desired.

In order to release wedge 31 for movement of lever 22 and tubular handle 24 about shaft 23, forked wedge extensions 32 (only one shown) are provided to terminate in a block 33. Rod 34 is threaded at one end into this block and knob 35 at the other end. Pressure on the knob of course is transmitted through the rod 34, block 33, and extension 32 to release wedge 31 from the notches and thereby permit movement of the handle about shaft 23, as will be evident from a study of FIGURE 1. Upon release of manual pressure applied to knob 35, the spring pressure exerted on wedge 31 will restore the linkage to locked condition.

Through the connection between forked lever 22 and pin 21, oscillation of handle 24 produces vertical rectilinear movement in valve stem 20 (compare FIGURES 1 and 3, for example), which of course raises or lowers valve elements 11, 12 supported on the stem. In the fully open position of valve mechanism 10 (FIGURE 3), wedge 31 engages the lower surface of quadrant 26, as shown. Another notch could be provided to lock the mechanism in a raised position, if desired.

The lowermost, sealing, valve element 12 is rigidly attached to valve stem 20 through the use of a conventional raised shoulder and retaining ring, as will be apparent from inspection of the drawings. A rubber rim 36 is secured within a recess in the peripheral surface of element 12 and promotes a sealing function when urged against the conical surface 15 of bottom plate 13. Both

elements 11 and 12 of course are circular to afford uniform contact with the conical surface 15, but mating surfaces of other geometric configuration could be provided if found to be necessary or desirable.

Uppermost or feed control valve element 11 is spring-suspended onto valve stem 20 by means of a pressure spring 37. This spring is compressed slightly between flange 38 on the upper end of the stem and closure plate 40 forming a part of control element 11, as shown in FIGURE 1, but may be further compressed to the FIGure 4 position, thereby permitting relative movement between elements 11 and 12 to accommodate the sealing function. Closure or pressure plate 40 may be secured to element 11 by any conventional means, such as the bolts shown. The valve element 11 is recessed as indicated at 41, to receive both stem 20 and the spring mechanism, and is provided with a tapered or conical outer surface to facilitate flow of granular material.

In the FIGURE 1 position, with wedge 31 engaging the first notch 27 in quadrant 26, the flow of granular material in hopper 14 is discontinued, but chips remaining within the confined passageway surrounded by seating surface 15 may be evacuated because the sealing element at this stage is open. The instant valve mechanism operates satisfactorily even if chips are lodged between element 11 and seat 15, because the feed control element is not depended upon for the sealing effect.

With attention now directed to FIGURE 4, note that handle 24 has been manipulated to shift wedge 31 into the second notch 28 in quadrant 26, thereby lowering valve stem 20 even further to urge elastic rim 36 of sealing element 12 into contact with seating surface 15. Feed control element 11 remains in the FIGURE 1 position, however, due to the lost motion action afforded by spring 41. Note further in connection with FIGURE 4 that the wedge 31 so engages the aforesaid second notch 28 that a cam action results to continuously urge elastic rim 36 into sealing position. The same effect is afforded element 11 by pressure spring 41.

In the open position shown by FIGURE 2, the chips or granules are permitted to gravitate downwardly through discharge opening 16, 17. If the flow is to be stopped and the mass of granules still present over the valves is to be sealed off, the handle 24 is shifted from the FIGURE 3 position to that shown in FIGURE 1, where the rim of element 12 engages its conical seat and stops the flow. Thereafter, all the granules and dust still remaining on the seat may gravitate from underneath the rim of the element 11, as a result of which the valve seat for the sealing element 12 is cleared.

Next, the spherical-shaped knob 35 is pressed, as a result of which wedge 31 is released from the FIGURE 1 position and is moved further upwards until it clicks into the second notch 28, as shown in FIGURE 4. During this movement of the handle the valve stem 20 is pulled down against the pressure of the wedge spring. As a result, the sealing rim is pressed firmly against its seat, thereby sealing the confined passageway in a gas-tight manner. It has been found that the apparatus thus described is reliable, capable of rapid operation, and permits a rapid discharge of containers filled with granules. Moreover, the mechanism is substantially fool-proof in operation and provides an accurate control to the flow of granular material.

Since it will be obvious that many alternatives and modifications will become apparent from a study of this disclosure, it is intended that the present invention be limited in scope only to the extent set forth in the following claim.

What is claimed is:

Apparatus for dispensing material comprising a storage compartment having an inner surface tapered to facilitate the flow of material vertically therefrom, a bottom plate secured to a lowermost edge of said storage compartment, means defining at least one material passageway and a

valve stem aperture in said bottom plate, a valve stem supported for vertical movement in the aperture of said bottom plate, means on an uppermost side of said bottom plate defining a conical valve seating surface, a valve sealing element rigidly secured to said valve stem intermediate the ends thereof in alignment with and overlying said conical surface, a flow control element supported by an upper end of said valve stem for movement relative thereto in alignment with and overlying both said valve sealing element and said conical surface, spring means urging said flow control element toward said valve sealing element, a quadrant secured to said bottom plate, an actuating lever pivotally supported to said bottom plate and being connected at one end to a lowermost end of said valve stem for transmitting motion thereto, the opposite end of said actuating lever extending alongside said quadrant for cooperation therewith, said quadrant and said actuating

lever being releasably connected with a wedge and at least one tapered notch affording a cam action for continuously urging said sealing and flow control elements against said conical valve seating surface, and means for disconnecting said quadrant and actuating lever for moving said sealing and flow control elements between sealed and unsealed positions to dispense or terminate dispensing of material from said storage compartment.

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