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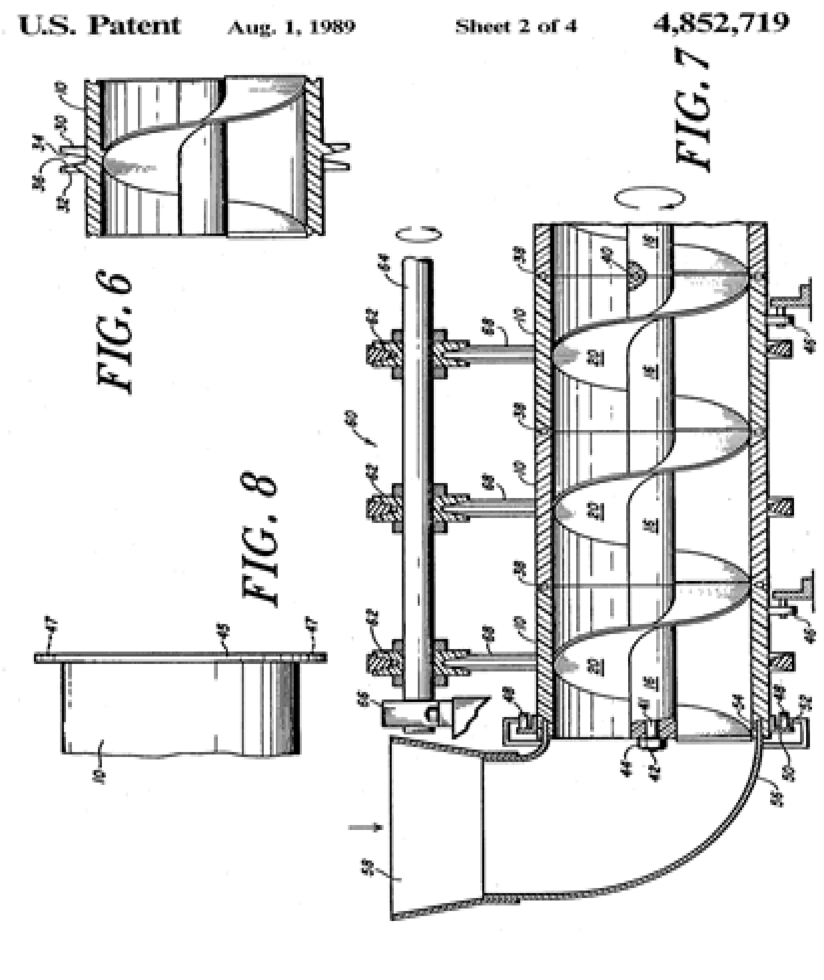
MODULAR SCREW CONVEYOR

Abstract

A screw conveyor composed of a plurality of modules mated end to end and of identical integrally molded construction. Each module is molded of a suitable plastic material and has integrally formed therewith a cylindrical body, a coaxially disposed tube within the body, and a web helically disposed between the coaxial tube and the cylindrical body. The module includes ends mateable with corresponding ends of like modules to provide a screw conveyor of intended length and which is rotatable as a single unitary structure. Each module may have a sheave integrally molded thereon for mating with a V-belt drive. Alternatively, the modules can be of open form each having a helical web molded on a central tube preferably having a non-circular and adapted for end to end mating with like modules to provide a screw conveyor of desired length. This open type of screw conveyor can be readily retrofitted to systems having conventional metal conveyor screws.



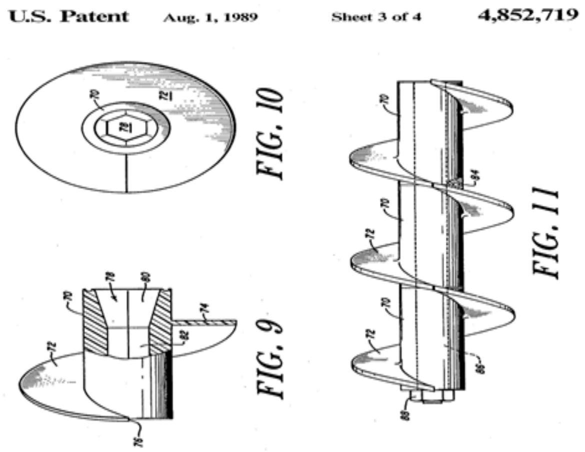
BACKGROUND OF THE INVENTION

Screw conveyors are well known for the transport of bulk material. Such conveyors generally include a helical screw disposed within housing, often of trough like form, and rotatable about its longitudinal axis to cause propulsion of bulk material along the length of the screw. Conveyors of known construction are usually fabricated of metal and are constructed to an intended finished size to provide a conveyor of intended length. Screw conveyors have also been constructed of modular or segmented form to provide sections which can be assembled into a complete conveyor of a desired length. Examples of segmented or modular conveyors are shown in U.S. Pat. Nos. 349,233; 525,194; 1,867,573; 2,394,163; 2,492,915 and 3,178,210.

SUMMARY OF THE INVENTION

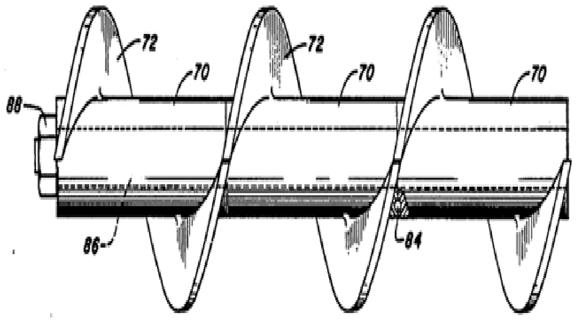
conveyor composed of identical end to end mated modules, each module being of integral plastic molded construction. Each module inThe present invention provides a screw cludes a body of cylindrical configuration, a tube coaxially disposed within the cylindrical body and having an opening extending there through, with a web helically disposed between the coaxial tube and cylindrical body. The ends of the body and coaxial tube are configured to seemingly engage like ends of mated modules, and the respective ends of the helical web include surfaces mateable with corresponding surfaces of the modules. The modules are axially mated to form a conveyor of desired length, the mated modules being retained in engagement by a tensile member such as a rod disposed through the aligned openings of the coaxial tubes and operative to provide an intended compressive force on the engaged modules. Alternatively, the modules can be secured in engagement by other means such as flanges on the ends of the body. The module body, coaxial tube, and helical web are integrally molded of a suitable plastic material, typically by an injection molding process. Each module may include a sheave integrally formed with the body which is composed of a plurality of spaced segments to define a V-groove configured to mate with a V-belt of an exterior drive. Alternatively, sprocket teeth may be integrally formed with the module body to mate with a chain drive, or other driving means can be employed.

In the embodiment described above, the helical web is integrally formed within a surrounding tube which provides a self-enclosure for the helical screw. The conveyor of the present invention can also be embodied in open form in which the module comprises a central tube preferably having a non-circular opening, about which the helical web is integrally molded. The ends of the central tube and ends of the web are mateable with the ends of the modules to provide a conveyor of desired length.



The modules are retained in compressive engagement by a tensile member such as a shaft of non- circular cross-section extending through the aligned non-circular openings of the central tubes, the rod also serving as a tensional drive shaft for the mated modules. This open type of screw conveyor driven by a central shaft is adapted to be readily retrofitted to existing conveyor systems which presently employ conventional metal conveyor screws.

The molded plastic conveyor of this invention offers major benefits over screw conveyors of conventional construction. The assembled modules offer smooth effectively continuous surfaces throughout the length of the conveyor with no hardware or other obstructions along the conveying surfaces. The novel conveyor is easily cleaned and can be molded of a variety of materials compatible with and suitable for particular operational purposes. The conveyor is not subject to rust or corrosion, as with many conveyors, and is of much less weight than a metal conveyor of the same size. The modular construction allows a single unitary module to be manufactured and stocked for assembly as necessary to achieve conveyors of different lengths. The modules can be easily shipped to an installation site and assembled on site for use. The conveyor can also be readily disassembled into its component modules such as for cleaning, shipping, or repair.



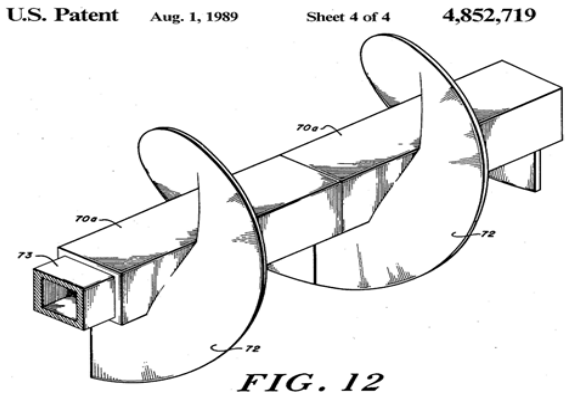


FIG. 12

DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which: FIG. 1 is a pictorial view of a screw conveyor module embodying the invention; FIG. 2 is an end view of the module of FIG. 1; FIG. 3 is a sectional view taken along lines 3—3 of FIG. 2; FIG. 4 is a pictorial view of an embodiment similar to that of FIG. 1 and including an integrally molded sheave thereon; FIG. 5 is an end view of the module of FIG. 4; FIG. 6 is a sectional view taken along lines 6—6 of FIG. 5; FIG. 7 is a sectional side view of a screw conveyor embodying the invention and composed of the modules of FIGS. 1-3; FIG. 8 is a cutaway side view of a module having alternative mounting means; FIG. 9 is a sectional elevation view of a further embodiment of a screw conveyor module of the invention; FIG. 10 is an end view of the module of FIG. 9; FIG. 11 is a side view of a screw conveyor embodying the invention and composed of the modules of FIGS. 9 and 10; and FIG. 12 is a pictorial view of a further embodiment of a screw conveyor module of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 1-3 of the drawing, there is shown an integrally molded module which is mated with like modules to form a screw conveyor of intended length. The module is molded of a suitable plastic material such as polyethylene, polypropylene or polyurethane and has integrally formed therewith all essential constituents of the screw conveyor. The module includes a body of tubular configuration having on the ends thereof circular grooves 12 and 16, respectively, for accommodation of an O-ring seal between mated modules. A tube 16 is coaxially disposed within body 10 and having an opening 18 extending there through, with a web 20 helically disposed between the inner surface of body 10 and outer surface of tube 16. The tube 16 includes on the respective ends thereof circular grooves 5 17 for accommodation of an O-ring seal. The web 20 is slightly less than one helical pitch length terminating in respective ends 22 and 24 which include radically parallel surfaces 26 adapted to confront corresponding surfaces of like modules. Thus, the surface 26 of helix end 10 22 is adapted to confront the oppositely facing edge of end 24 of an adjacent module. The web ends extend outward of the confronting ends of body 10 typically by approximately 1/2 the wall thickness of the web, as illustrated. By having the length of the helical web 15 slightly less than the helical pitch it is possible to injection mold the module by conventional molding techniques since as seen from FIG. 2 the two halves of an injection mold can open axially of the module which, because its helical length is slightly less than one helical pitch, presents no undercuts to the mold halves. Typically, the web length is about one percent less than the pitch length to provide sufficient clearance for mold tooling.

An embodiment similar to that of FIGS. 1-3 is shown in FIGS. 4-6 and includes a sheave integrally molded with the conveyor module. The sheave is provided around the body centrally disposed between the respective ends of the body, the sheave being composed of alternating segments. A first array of segments is disposed around the body in spaced circumferential arrangement. A second array of segments is axially spaced from the segments and is circumferentially disposed about body in spaced position staggered from the position of the segments, as illustrated. The confronting surfaces and of respective segments and define a V-groove, best seen in FIG. 6, configured to mate with a V-belt of an exterior drive. The module is otherwise the same as described above with respect to FIGS. 1-3. The staggered arrangement of the segments and allow injection molding by conventional injection molding techniques since the staggered arrangement as seen from FIGS. 4-5 permits the mold halves to open axially of the module and presents no undercuts to the mold halves.

The module of FIGS. 1-3 is axially mated with like modules, as shown in FIG. 7, to form a conveyor of desired length. Each of the modules is aligned with the ends of adjacent bodies in engagement with an interposed O-ring, and with the ends of adjacent tubes in engagement with an interposed O-ring. The helical webs have their edges confronting to provide an effectively continuous helical screw disposed within the continuous tubular body formed by the mated modules. Since the web is slightly less than one helical pitch length, small spaces exist between the confronting web ends of mated modules. Typically, the gap between confronting web ends is about 0.1 inch for a web of eight inch diameter. The small spaces between the confronting ends of the helical web are of little consequence to the ability of the assembled screw to convey most products.

The small spaces may be filled in with material which is the same as or compatible with that of the module. For example, molded strips of plastic material can be inserted into the small spaces between web ends and fused therein, such as by hot gas welding, to produce a helical web having fully continuous surfaces. The elimination of the small gaps is useful in some applications such as where sanitary conditions require. For most conveying purposes, the small spaces are not of any consequence.

The mated modules are maintained in engagement by a tensile member disposed within the openings of tubes. This member typically is a metal rod 41 having threaded ends 42 and fasteners 44 which are tightened to provide an intended compressive force on the engaged modules. Alternatively, the tensile member can be a wire, plastic, or other rope disposed within the openings 18 of tubes 16 and tensioned by appropriate fasteners on the respective ends of the rope. In cases where the conveyor is subject to changes in temperature, it would be preferable to have a tensile member which allows for expansion and contraction of the conveyor while maintaining the axial compressive force on the mated modules. The tensile member should be of a material having thermal expansion and contraction characteristics in relation to those of the modules to maintain a compressive load on the mated modules even during temperature cycling.

The modules can alternatively be secured together by means other than a tensile member. One such alternative is illustrated in FIG. 8 in which the body 10 includes on each end thereof an integral flange 45 having openings 47 disposed about the circumference of the flange and through which fasteners are insert able for securing mated ends together.

The mated modules may be supported for rotation on rollers 46. Typically, an array of three circumferentially spaced rollers is provided near each end of the conveyor body. Additional rollers can be provided as necessary, depending upon the length of the particular conveyor. Axial positioning of the conveyor body is maintained by horizontally disposed rollers 48 at each end of the body, these rollers being circumferentially spaced about the periphery of the body. A flange 50 is attached to the end modules of the conveyor and includes a circular surface 52 which is cooperative with the rollers 48 to maintain the axial position of the rot able body. A slip seal can be machined or otherwise formed in the outer end of the outermost module. In the illustrated embodiment, the slip seal is in the form of an annular groove 54 into which an end of a feed tube 56 is inserted, and with respect to which the conveyor body is rotatable. The feed tube 56 is typically connected to a hopper 58 into which a product is fed (as shown by the arrow) for conveyance.

The drive assembly 60 includes sheaves 62 carried by and rotatable with a shaft 64 which is supported on bearing blocks 66 and which is driven by a motor (not shown). The shaft 64 is spaced from and parallel to the conveyor body, and each sheave 62 may be in association with a respective conveyor module. V-belts 68 couple the drive sheaves 62 to the conveyor modules and by which power is transmitted to the conveyor body for rotation thereof. In the illustrated embodiment, each of the modules is driven by an associated conveyor belt coupled to the drive assembly. All of the conveyor modules need not be driven, and the driven number will be determined in accordance with the motive force necessary to rotate the conveyor for particular applications.

If the modules of FIGS. 4-6 are employed, the sheaves 28 are operative to engage the V-belts 68 for driving the conveyor. It is appreciated that the conveyor can be driven by other than V-belts. For example, chain sprockets can be formed on or attached to the modules for cooperation with a chain drive.

Another embodiment of the invention is shown in FIGS. 9 and 10 and includes a screw conveyor module having a central tube 70 of cylindrical exterior form, with a non-circular opening there through and with a web 72 helically disposed about the central tube. The helical web is slightly less in length than one helical pitch length, as described, and terminates at edges 74 and 76, these edges being adapted to confront corresponding edges of adjacent modules. The opening 78 through the central tube is of non-circular cross-section at end portions 80 and tapers to a non-circular cross-section at a central portion 82. This tapering is slight and is provided as "draft angle" to facilitate removal of the module from axially separable molds. The opening is configured to mate with a non-circular shaft which serves as a tensile member to lock the modules into axial engagement and which also serves as a positive drive shaft for rotation of the conveyor. In the embodiment of FIGS. 9 and 10, the opening is illustrated as hexagonal, although other noncircular shaped openings can be provided in tube for use with a correspondingly shaped shaft to prevent rotation of the engaged modules relative to the shaft.

A screw conveyor composed of the modules of FIGS. 9 and 10 is shown in FIG. 11. Each of the modules is aligned with the ends of adjacent central tubes 70 in engagement with an interposed O-ring 84, and with the helical webs 72 having their ends confronting to provide an effectively continuous helical screw. A shaft 86 is fitted through the openings 80 through the tubes 70 and is secured by end fasteners, such as nuts 88 threaded onto threaded ends of shaft 86, which are tightened to provide an intended compressive force on the interconnected modules, as described above. This embodiment of FIG. 11 can be employed to retrofit existing metal screw conveyors without material change to the drive system.