United States Patent

[11] 3,584,842

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[45] Patented **June 15, 1971**

[54] **APPARATUS FOR AERATING STORED GRAIN**
7 Claims, 10 Drawing Figs.

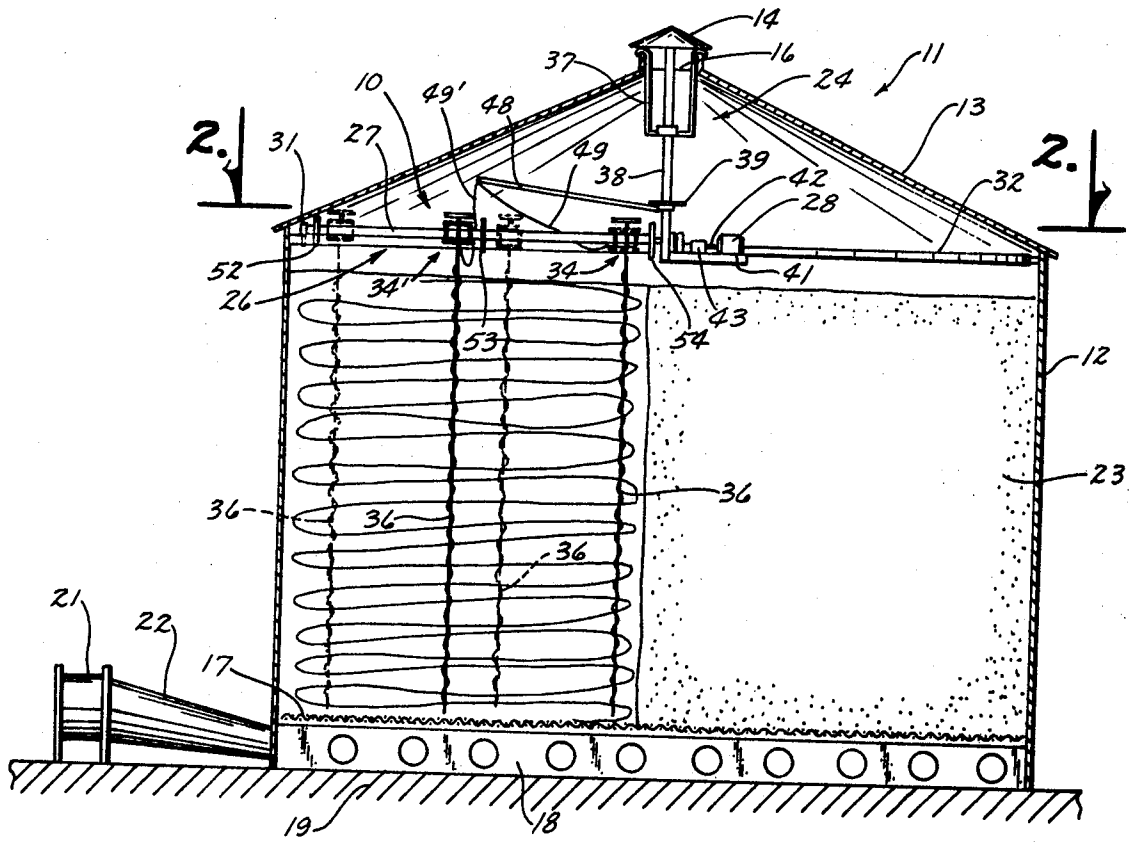
[52] **U.S. Cl.** **259/102,** 259/111
[51] **Int. Cl.** **B01f 7/00**
[50] **Field of Search** 259/102, 95, 111, 5, 7, 8, 16, 21, 22, 32, 33, 40, 42, 64, 65, 66

[56] **References Cited**
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ABSTRACT: An apparatus for aerating grain stored in an enclosure by mechanically moving a stirring apparatus therethrough. The apparatus comprises a vertically disposed element which is rotatably mounted on a carriage movable itself back and forth on a flightless, smooth tubular member which is rotated about its own axis as it is moved over the stored grain. The tubular member is supported above the grain by means connected to the enclosure and a motor is provided for both rotating and moving the tubular member.



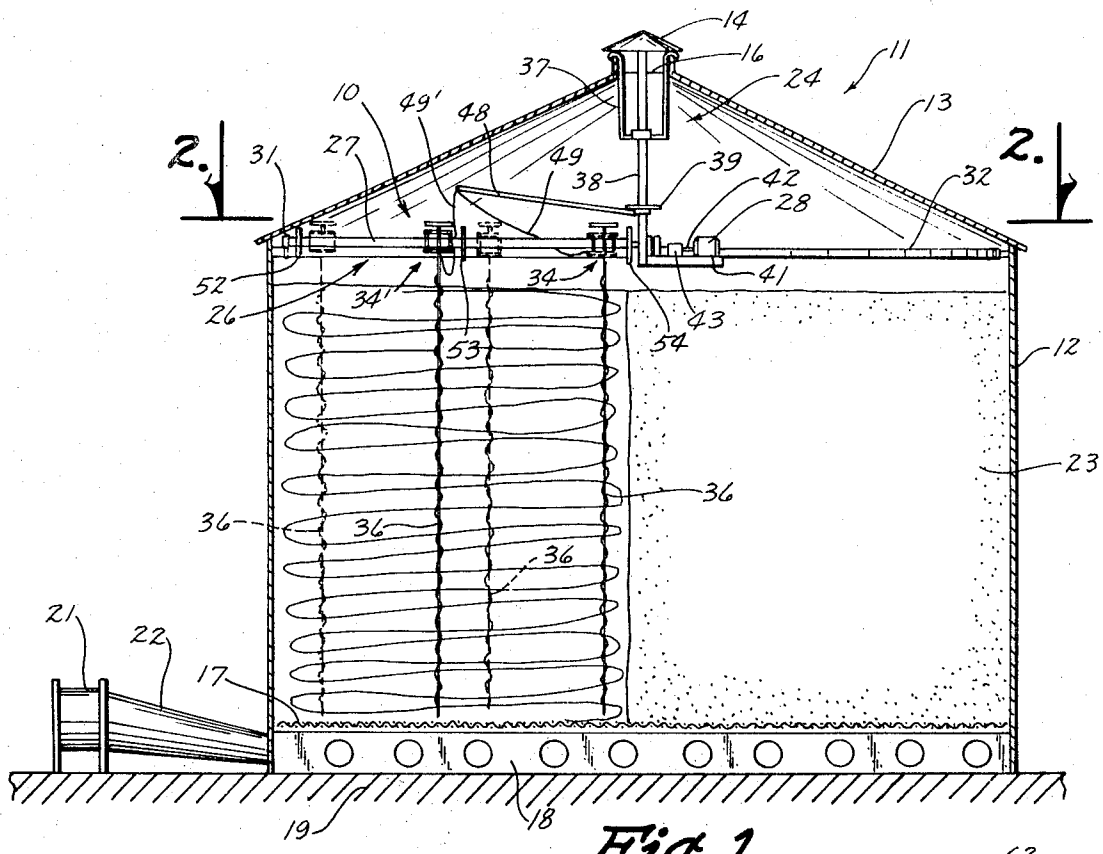


Fig. 1

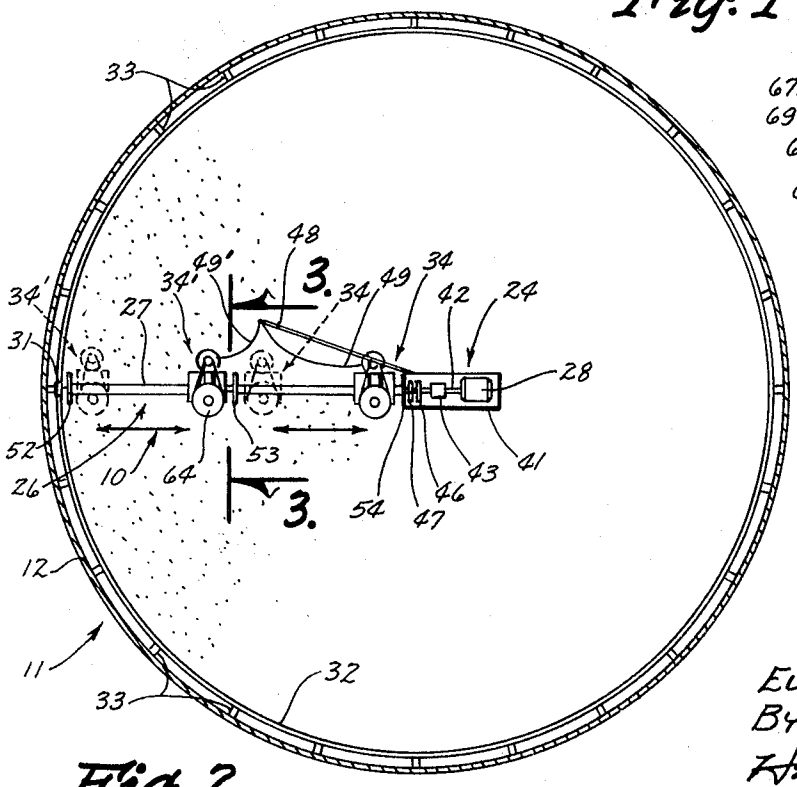


Fig. 2

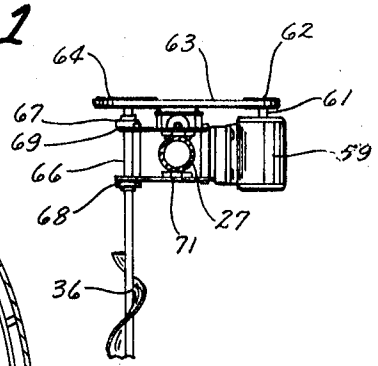


Fig. 3

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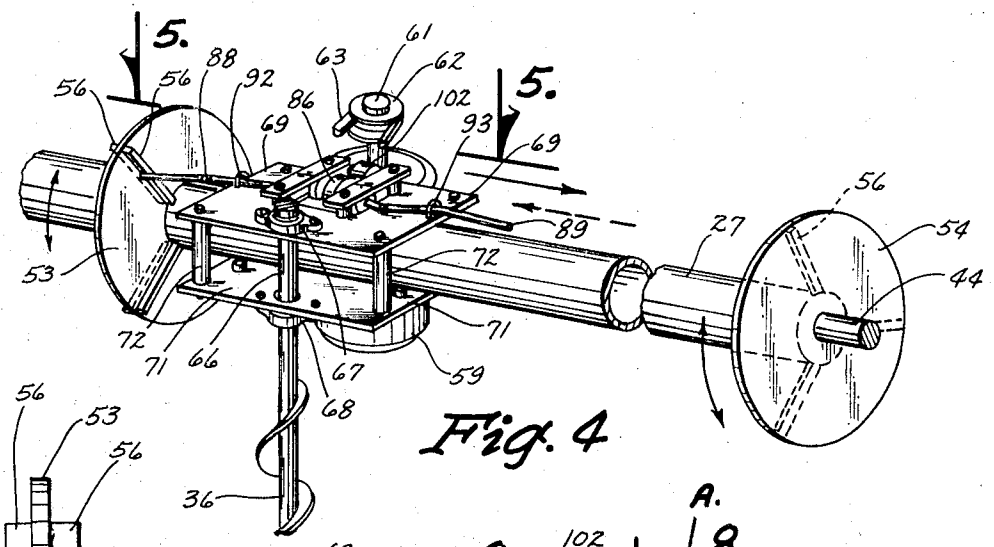


Fig. 4

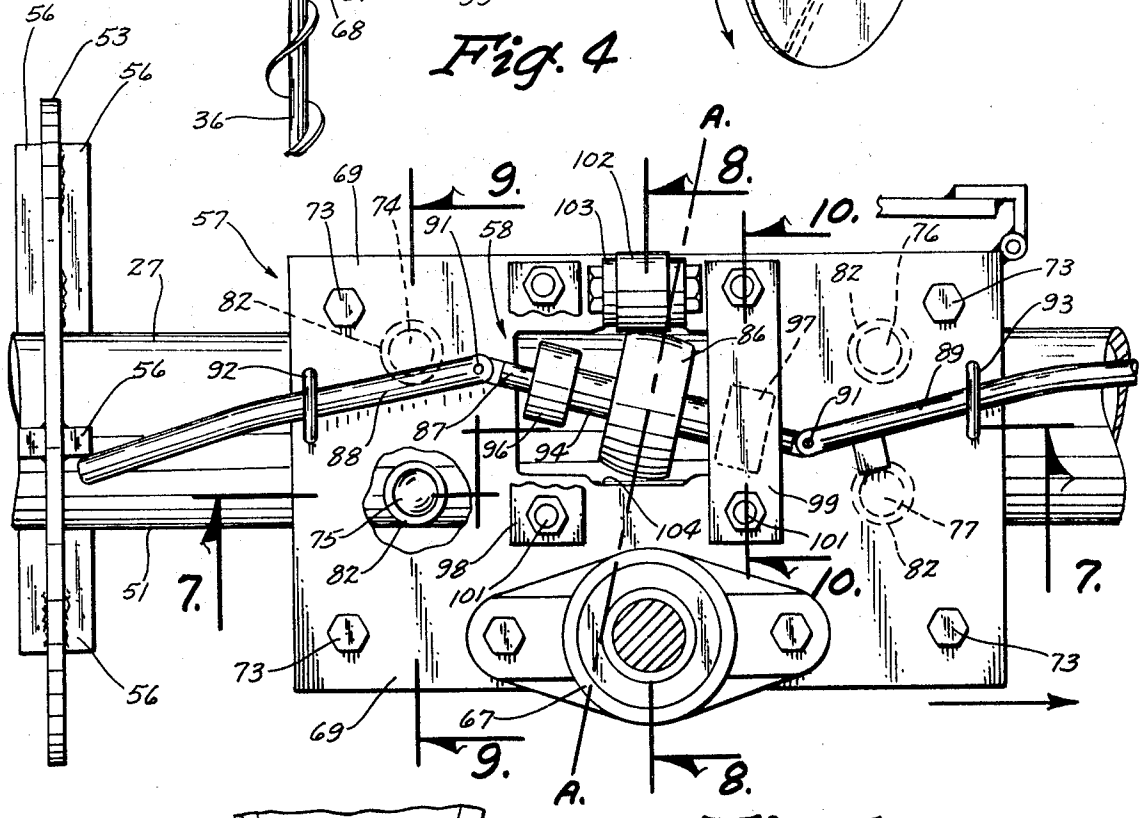


Fig. 5

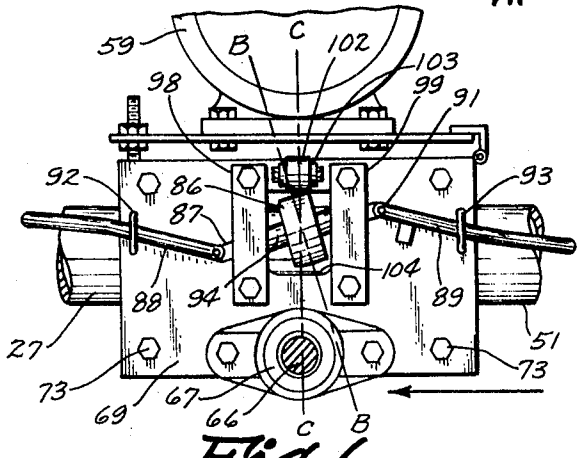


Fig. 6

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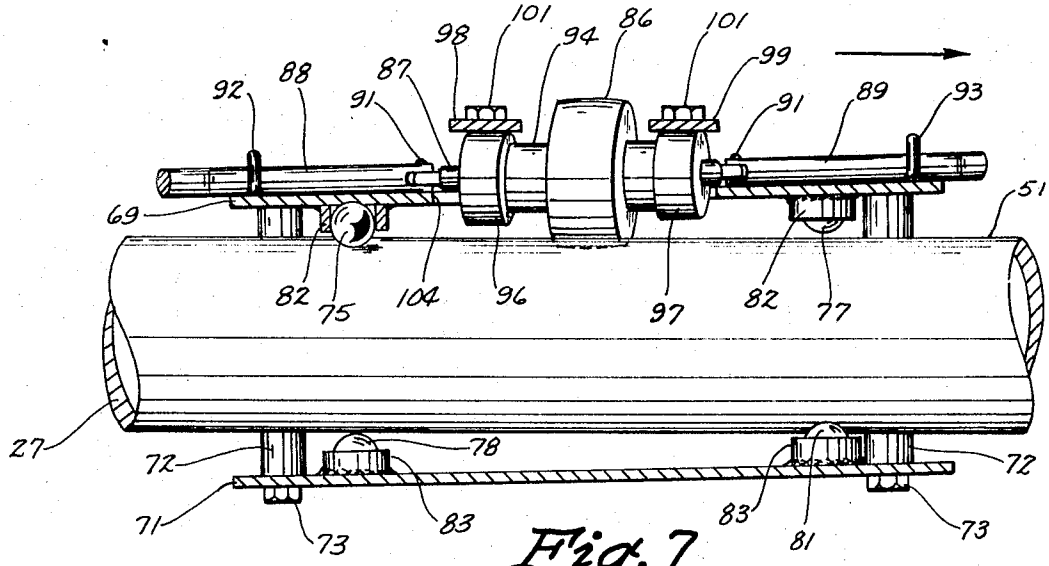


Fig. 7

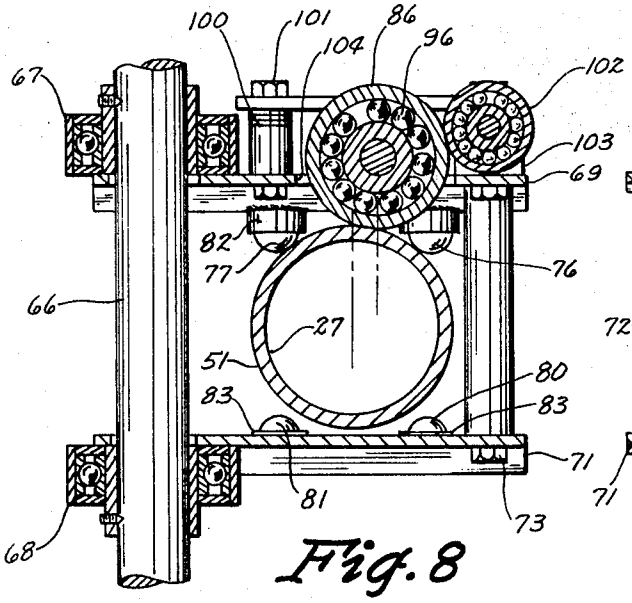


Fig. 8

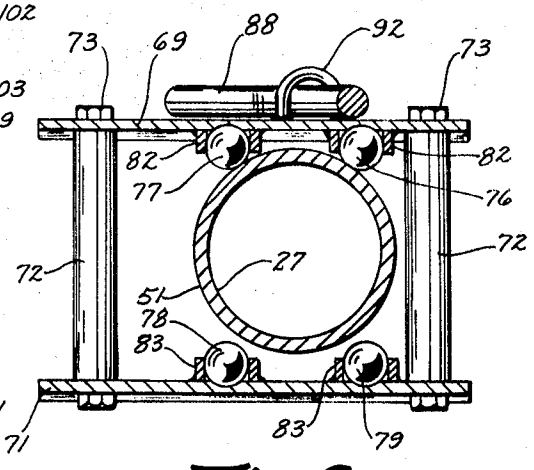


Fig. 9

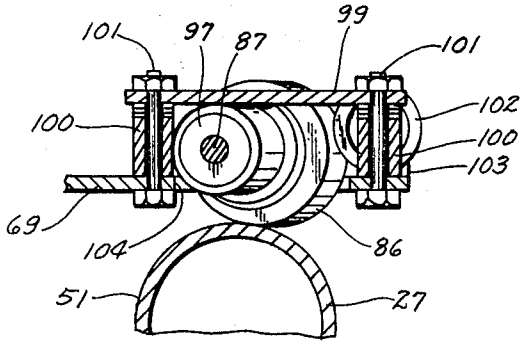


Fig. 10

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APPARATUS FOR AERATING STORED GRAIN

BACKGROUND OF THE INVENTION

It has been found that to stir or agitate grain stored in a bin or the like shortens the drying time requirements and prevents the formation of crusts or hot spots on top of and within particularly the upper layers of the grain. It is now generally accepted that mechanical grain-stirring devices eliminate overdrying, cut drying costs, and increase drying capacities of conventional grain bins.

Applicant's issued U.S. Pat. No. 3,272,480 best illustrates the type of apparatus with which this invention is concerned, and shows that one former requirement was the reversing of direction of an augerlike conveyor, which required a reversible motor and the switching therefor, and which required further a continual stopping of the rotation of the conveyor in one direction, and a starting of the rotation in the opposite direction. It is to obviate this requirement, among other advantages, which is the purpose of this invention.

SUMMARY OF THE INVENTION

This invention relates to a grain-moving apparatus for operation within an enclosure, a grain storage bin, for example. The apparatus comprises a vertically disposed auger of sufficient length to extend substantially the entire height of the bin above a bottom floor so that the auger extends throughout all grain therein. The upper end of the stirring auger is connected to a frame which carries a motor for rotating the auger by remote control.

The frame is mounted by antifriction balls on an elongated, smooth-surfaced tube which is movably supported on the enclosure above whatever grain is placed within the bin. Means such as a motor also remotely controlled are provided for rotating the tube about its longitudinal axis, and for moving the tube simultaneously or independently of such rotation over the grain.

Also mounted on the frame and in contact with the tube is a friction unit, opposite end portions of which are alternately engageable with a pair of control devices, such as a pair of plates each having a diameter larger than that of the tube, and which are secured in axially spaced relation to the tube. The unit, as determined by which end portion thereof is engaged and moved by a plate, assumes one of two alternate positions on the tube, whereupon rotation of the tube in one constant direction of rotation effects axial movement of the frame repeatedly back and forth between the plates.

The principal object of this invention is the provision of an improved grain-aerating apparatus.

Another object of this invention is to provide a grain-stirring apparatus utilizing a horizontally disposed, axially rotatably tubular member as the conveyor for a stirring auger-carrying frame, wherein the tubular member need only rotate in one direction.

Still another object of this invention is an apparatus as defined hereinbefore wherein the tubular member has a smooth outer surface with a constant outer diameter substantially the entire length thereof.

Yet another object of this invention is to provide an apparatus capable of attaining these objectives which is economical, easily manufactured and effective in operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a conventional grain bin, showing the apparatus of this invention mounted therein;

FIG. 2 is a a plan view of the apparatus of FIG. 1 taken along the line 2–2 in FIG. 1;

FIG. 3 is an enlarged, partial side elevational view taken along line 3–3 in FIG. 2;

FIG. 4 is an enlarged, foreshortened, perspective view of a portion of the apparatus of the invention;

FIG. 5 is an enlarged plan view as taken along the line 5–5 of FIG. 4;

FIG. 6 is a reduced view similar to FIG. 5, and wherein a friction unit is shown in a position opposite that of FIG. 5;

FIG. 7 is a side elevational view as taken along the line 7–7 in FIG. 5;

FIGS. 8 and 9 are vertical sectional views as taken along the lines 8–8 and 9–9 in FIG. 5; and

FIG. 10 is a partial sectional view as taken along the line 10–10 in FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the grain-moving apparatus of this invention is depicted generally at 10 in FIGS. 1 and 2, and is adapted for use inside a commercially available grain bin 11. The bin 11 comprises a circular sidewall 12 of galvanized steel having an umbrella-type roof 13 supported thereon, which roof is provided with a ventilator cover 14. The ventilator may be adjustable to regulate the airflow therethrough, as is conventionally provided.

An opening 16 of a circular design is formed in the upper portion of the roof 13, with a series of arcuate pockets (not shown) formed about the opening 16 by the metal joints of the roof panels. At the bottom of the grain bin 11, a circular perforated drying floor 17 is provided which is mounted on a steel understructure which includes a plurality of floor channels 18 (FIG. 1). The grain bin 11 as a whole is mounted on a concrete foundation 19.

For supplying fresh air internally of the bin 11 for passage through the grain therein, a fan 21 (FIG. 1) is mounted on a portion of the foundation 19, and upon operation, forces air through a transition unit 22 so that the air passes beneath the perforated floor 17 and then upwardly through the grain 23 which has been transferred into bin 11.

Generally, the apparatus 10 comprises a support unit 24 (FIG. 1) attached to the roof 13; a conveyor unit 26 mounted on the support unit 24 and rotatable in a circular direction thereabout, the unit 26 including a horizontally disposed shaft 27 and a motor 28 therefor; a wheel 31 attached to the outer end of the shaft 27; a circular track 32 for receiving the wheel 31 and which is mounted on a plurality of brackets 33 (FIG. 2) secured about the wall 12; a frame unit, of which a pair 34 and 34′ (FIGS. 1 and 2) are shown, which units 34 and 34′ are rotatably mounted on the shaft 27 so as to be movable longitudinally thereof; and a vertically disposed auger 36 operably connected to each frame unit 34 and 34′ and depending into the grain 23 for tumbling same upon rotation of the auger 36, and for moving the grain upwardly relative to an auger 36 due to the flighting thereof.

More specifically, the support unit 24 comprises a plurality of strap fasteners 37 (FIG. 1) the upper ends of which hook over the open upper edge of the cover 14. A bracket 38 depends centrally from the fasteners 37 and has a bushing device 39 at its lower end. The underside of the device 39 rotates horizontally 360° about the upper side thereof, and from the underside of which an L-shaped structure 41 depends.

Mounted on the upper horizontal side of the structure 41 is the motor 28 (FIG. 2), the power shaft 42 of which extends into a gearbox 43. The inner end 44 of the shaft 27 extends through a pair of bearing blocks 46 and 47 mounted on the structure 41 and into the gearbox 43. Electric power is provided to the motor 28 and to a swivel switch mounted below the device 39. A rotatable boom 48 suspends a pair of electric cables 49 and 49′ to the respective frame units 34 and 34′ for supplying electricity thereto at all times during operation of the apparatus 10, and provides a means for electrically connecting the frame units 34 and 34′ to the motor 28 for a reason described hereinafter.

The conveyor unit 26 comprises the shaft 27, a trio of plates 52, 53 and 54 which are mounted in a predetermined spaced relation on the shaft 27. Each plate is provided with a plurality of beads 56 (FIGS. 4 and 5) which face, on an appropriate side of the plate, a frame unit 34 or 34′. For properly operating each frame unit, a pair of plates are provided, and it is readily appreciated that but one additional plate is needed for

the addition of a frame unit. As will be described more in detail hereinafter, the travel of a frame unit **34** and **34'** longitudinally of the shaft **27** is entirely dependent upon the longitudinal spacing of the plates **52, 53** and **54**.

The shaft **27** itself, as best depicted in FIGS. **1, 4, 7,** and **8,** is of tubular nature, having a smooth outer surface **51** with a constant outer diameter substantially the entire length thereof.

As each frame unit **34** and **34'** is identical, only one will be described with like reference numerals indicating like elements. Referring primarily to FIGS. **4—10** inclusive, the frame unit **34** includes a frame **57** and a friction drive unit **58,** plus a motor **59** (FIGS. **4** and **6**). The motor **59** provides drive through its output shaft **61** and a pulley **62** for a belt **63** and a pulley **64** to transmit said drive to the upper end **66** of the auger **36,** which upper end **66** is rotatably inserted through bearing blocks **67** and **68** secured to the top piece **69** and bottom piece, respectively, **71** of the frame **57**.

The frame top **69** and bottom **71** are mounted in parallel and spaced relation above and below the shaft **27** by means of spacers **72** and capscrews **73** therefor, and with the interconnected top and bottom pieces **69** and **71** of the frame being movable longitudinally and circularly of the shaft **27** by means of antifriction balls **74, 75, 76,** and **77** secured to the undersurface of the top piece **69** within a plurality of seats **82,** and also by a plurality of balls **78, 79, 80,** and **81** which are mounted on the upper surface of the bottom piece **71,** again by a plurality of seats **83,** as best illustrated in FIG. **9**.

The longitudinal and lateral spacing of the upper balls **74—77** inclusive and the lower balls **78—81** inclusive are identical as related to the top and bottom pieces **69** and **71** of the frame **57,** and the transverse relationship between the two sets of balls is such that the balls are diametrically opposed as best illustrated in FIGS. **8** and **9**. The diametrical spacing is such that whereas, for example, the top two balls are engaged with the shaft surface **51,** the lower two are slightly spaced therefrom. Provision can be made for biasing all eight balls into contact with the shaft surface **51,** but as presently constructed, usually the top two balls of one set and the lower two balls of another set are in contact with the shaft **27,** which ones depending on the direction of movement of the frame unit.

The friction unit **58** includes a main bearing roller **86** mounted on a middle, straight rod **87** for rotation about an axis parallel to the axis of rotation of the shaft **27,** as viewed in side elevation in FIG. **7,** for example. The main roller **86** engages the upper surface of the shaft **27** (FIG. **8**) due to the weight of the frame unit **34**. The rod **87** has pivotally connected to its outer ends an outer rod **88** and an inner rod **89,** as by a pair of pins **91,** which rods are substantially identical to each other, being straight in one plane as viewed in FIG. **7,** and slightly bent in another plane as viewed in FIGS. **5** and **6**.

The outer rod **88** and the inner rod **89** are loosely passed through a pair of loops **92** and **93** (FIG. **4**) secured to the top piece **69** of the frame **57,** such that the three rods **87—89** are capable of being in substantially straight alignment, or of assuming a first position wherein the main roller **86** is rotatable in a first plane (A–A, FIG. **5**) angularly related to the plane (C–C, FIG. **6**) of rotation of the shaft **27,** and of assuming a second position wherein the main roller **86** is rotatable in a second plane (B–B, FIG. **6**) also angularly related to the plane C–C, with the planes A–A and B–B being on opposite sides of the shaft transverse planes C–C.

A bearing shaft **94** (FIGS. **5** and **8**) mounts the roller **86** on the rod **87,** acting as an inner race, and also acts as a mounting for a pair of smaller ball bearings or rollers **96** and **97,** and which rollers transfer the weight of the frame unit **34** to the main roller **86** by means of a pair of flat bars **98** and **99** (FIGS. **5, 7,** and **8**). The bars **98** and **99** are secured as by capscrews **101** to the top piece **69,** with each bar directly over a roller **96** and **97** (FIGS. **5** and **7**). Spacers **100** separate the bars **98** and **99** from the top piece **69**.

Another ball bearing or roller **102** (FIGS. **5** and **8**) is provided for lending lateral support to the main roller **86,** which roller **102** is mounted directly to the top of the top piece **69** by a mounting block **103** so that its rolling surface is in constant engagement with the rolling surface of the main roller **86** (See FIG. **5**). The support roller **102** rotates in a plane parallel with the plane C–C of rotation of the shaft **27**. It will be noted that a cutout **104** is formed in the top piece **69** so that swivel movement of the middle rod **87,** the main roller **86,** and the side rollers **96** and **97** is not impeded, and so of course that the main roller **86** is constantly in contact with the shaft **27**.

In operation, assume that both frame units **34** and **34'** are located on the shaft **27** in their full line position of FIG. **2,** and with the friction drive unit **58** of each frame unit positioned as illustrated in FIG. **6**. Power is supplied simultaneously to the shaft drive motor **28** to rotate the shaft **27** in one direction, counterclockwise for example, as viewed from the inner end of the shaft **27** toward the outer. Due to the angular relationship of the direction of rotational movement of the main roller **86** to the direction of rotation of the shaft **27,** the frictional relationship therebetween causes movement of the respective frame unit **34** and **34'** longitudinally of the shaft **27** and toward the outer end thereof, or toward the bin wall **12**. It will be appreciated that also as the wheel **31** at the outer end of the shaft **27** is rotating on the track **32,** this frictional relationship will cause the shaft **27** to move horizontally about the bin and over the grain **23** therein.

Each frame unit **34** and **34'** moves, therefore, longitudinally outwardly of the shaft **27** in response to rotation of the shaft, until a frame unit engages a plate. As best illustrated in FIGS. **4** and **5,** the counterclockwise rotation of the plate **53** will cause one of the beads **56** to engage the free end of the outer rod **88,** whereupon, due to the articulated arrangement of the rods **87—89,** they will be moved from the first position of FIG. **6** to the second position of FIG. **5,** it being seen that the axial direction of the middle rod **87** is thus reversed as compared to the longitudinal axis of the shaft **27**. Continued rotation of the shaft **27,** still in the same direction of rotation, i.e., counterclockwise, will then result in the frame unit **34** being moved longitudinally inwardly on the shaft **27,** again due to the frictional relationship between the shaft **27** and the main roller **86**.

Upon return from the dotted line position of FIG. **2** to the full line position thereof, a bead **56** of the plate **54** (FIG. **4**) would strike the free end of the inner rod **89,** whereupon the rods would be returned from the FIG. **5** position to the FIG. **6** position. Again, continued rotation of the shaft **27** in the same direction would result in the frame unit **24** being moved longitudinally outwardly on the shaft **27**.

It may be realized that the relative positioning of all elements of a frame unit **34** and **34',** and the augers **36** and **36'** therewith is such that in normal usage the top and bottom pieces **69** and **71** of a frame unit are horizontally disposed, as best shown in FIG. **8**. Each frame unit, however, as can readily be seen, has the capability of rotating circularly about the shaft **27** in order to adjust to the drag or resistance of the grain to the movement of the shaft **27**.

Although not depicted herein, it is readily envisioned that this arrangement may be used in a right-angular enclosure. Thus, both ends of the shaft **27** would be mounted by a pair of wheels **31** on a pair of parallel tracks **32,** and with operation of the motor **28** resulting in simultaneous rotation of the shaft **27** about its axis, and movement back and forth on the tracks **32**. Other than the motor **28** being reversible, and a reversing switch being provided at each end of the tracks similar to the reversing arrangement of U.S. Pat. No. 3,448,966, all other structure would be the same for enabling use of the apparatus **10** in an enclosure, the walls of which are right-angularly related.

I claim:

1. A grain-moving apparatus for operation within an enclosure, the apparatus comprising:

means including a vertically disposed, movable element;

conveyor means supporting said element means, said conveyor means rotatable about its own axis in one direction

of rotation to move said element means back and forth on said conveyor means;

means connected to the enclosure for supporting said conveyor means; and

power means for rotating said conveyor means.

2. A grain-moving apparatus as defined in claim 1, and further wherein said conveyor means includes a horizontally disposed member having a circular cross section substantially its entire length.

3. A grain-moving apparatus as defined in claim 2, and further wherein said member has a smooth outer surface of a constant diameter substantially its entire length.

4. A grain-moving apparatus as defined in claim 1, and further wherein said element means includes a frame unit mounted on said conveyor means and upon which said element is movably mounted, and includes further friction means engaged with said conveyor means and responsive to rotation of said conveyor means in one direction of rotation to move said frame unit alternately in opposite directions of rotation.

5. A grain-moving apparatus as defined in claim 4, and further wherein a pair of plates are secured to said conveyor means on opposite sides of said frame unit, and which plates are alternately engageable by said friction means, said friction means movable upon engagement with one plate to a first position wherein said frame unit is moved in one direction axially of said conveyor means, and said friction means movable upon engagement with the other plate to a second position wherein said frame unit is moved in an opposite direction axially of said conveyor means.

6. A grain-moving apparatus as defined in claim 5, and further wherein said friction means includes a circular member in frictional engagement with said conveyor means and mounted for rotation about an axis parallel to the axis of rotation of said conveyor means, said circular member in said first position of said friction means rotatable in a first plane angularly related to the plane of rotation of said conveyor and in said second position of said friction means rotatable in a second plane angularly related to the plane of rotation of said conveyor, said first and second planes on opposite sides of said conveyor plane.

7. A grain-moving apparatus as defined in claim 5, and further wherein said friction means includes a trio of articulated rod members the outer two of which are pivotally connected at one end each to an end of the middle rod member such that all three rod members are connected in a line, said middle rod having a roller rotatably mounted thereon which is rotatable about said middle rod as an axis,

said frame unit having a pair of loop elements secured thereto in spaced relation and aligned with the axis of said conveyor means, each loop element loosely receiving an outer rod member and whereby each rod member is movable in a plane parallel to the axis of rotation of said conveyor means, the outer end of each outer rod member engageable with one of said plates, rotation of a plate with said conveyor means capable of changing the relative positions of said rod members to each other and to said conveyor means, said middle rod member having opposite angular relationships to the longitudinal axis of said conveyor means in said first and second positions of said friction means.