Oct. 17, 1944. J. L. KOZAK ET AL 2,360,776

ELEVATING APPARATUS FOR HANDLING BULK MATERIALS

Filed Nov. 21, 1941 3 Sheets-Sheet 1

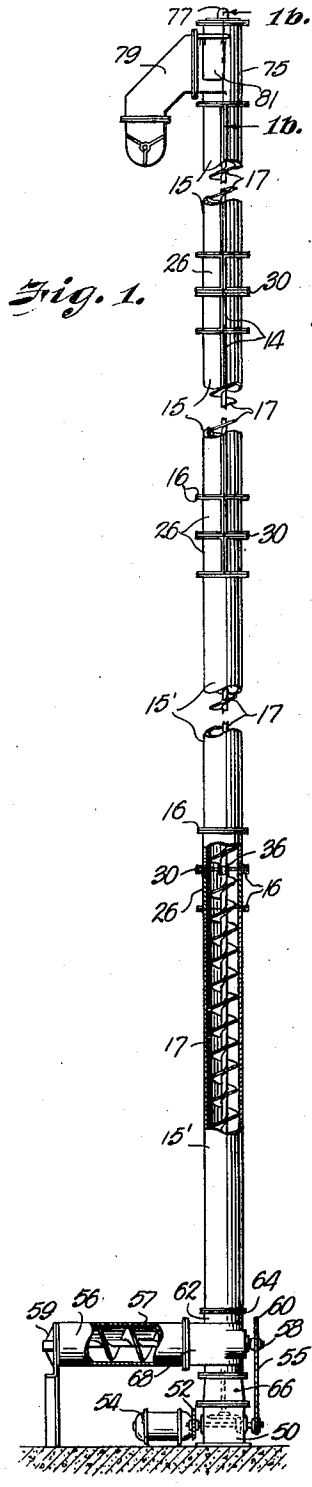


Fig. 1.

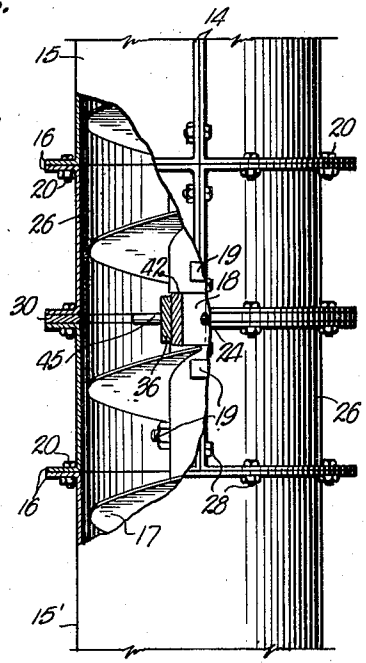


Fig. 2.

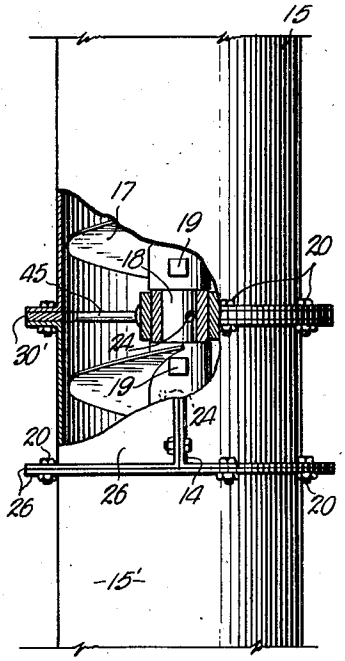


Fig. 4.

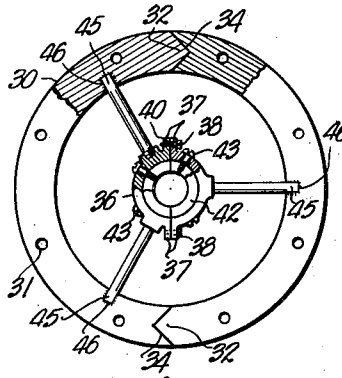


Fig. 3.

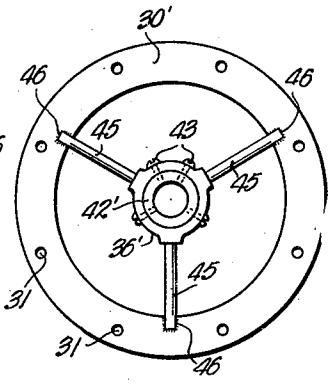


Fig. 5.

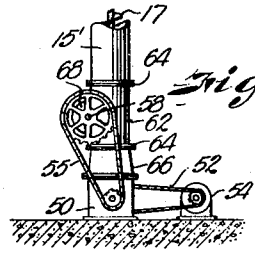


Fig. 1a.

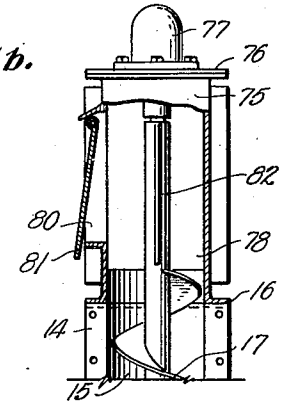
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Oct. 17, 1944. J. L. KOZAK ET AL 2,360,776

ELEVATING APPARATUS FOR HANDLING BULK MATERIALS

Filed Nov. 21, 1941 3 Sheets-Sheet 2

Fig. 1b.



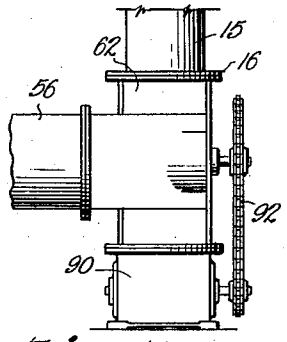


Fig. 11.

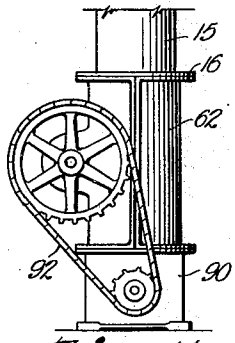


Fig. 11a.

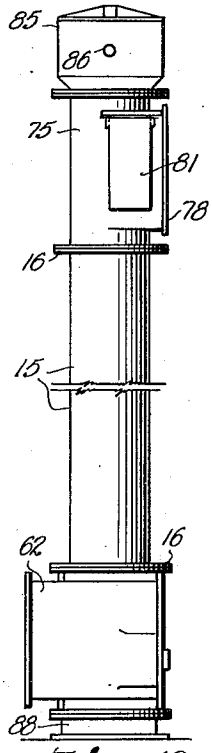


Fig. 10.

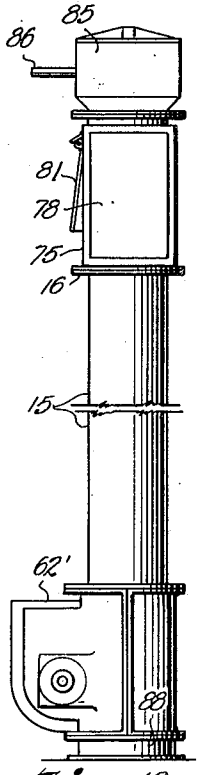


Fig. 10a.

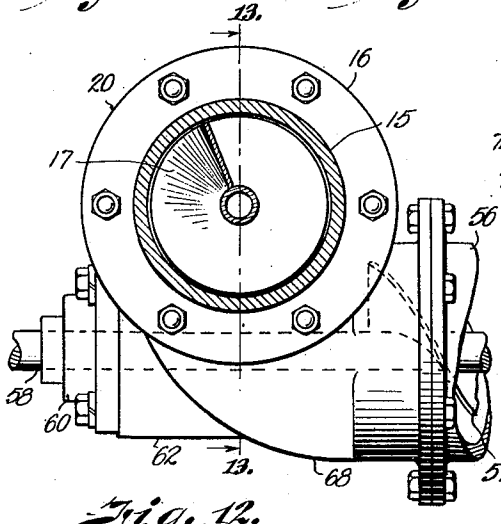


Fig. 12.

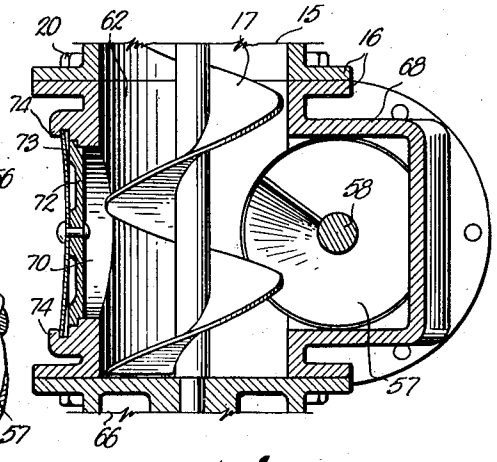


Fig. 13.

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Oct. 17, 1944. J. L. KOZAK ET AL 2,360,776

ELEVATING APPARATUS FOR HANDLING BULK MATERIALS

Filed Nov. 21, 1941 3 Sheets-Sheet 3

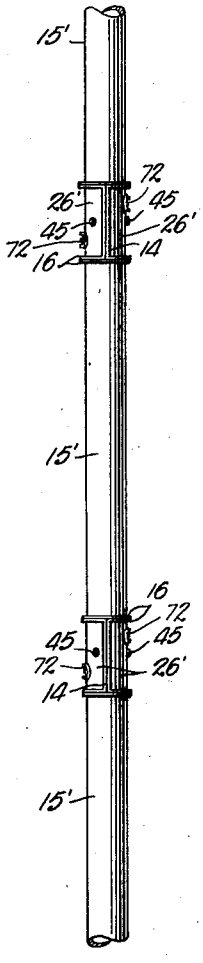


Fig. 6.

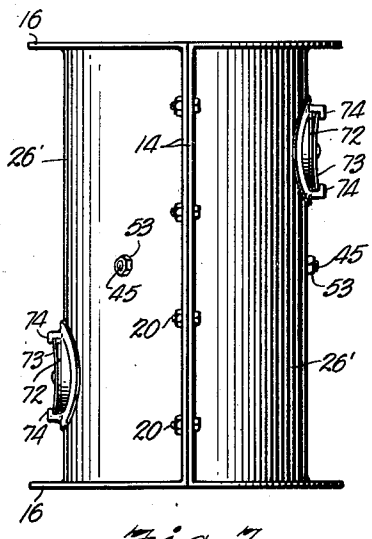


Fig. 7.

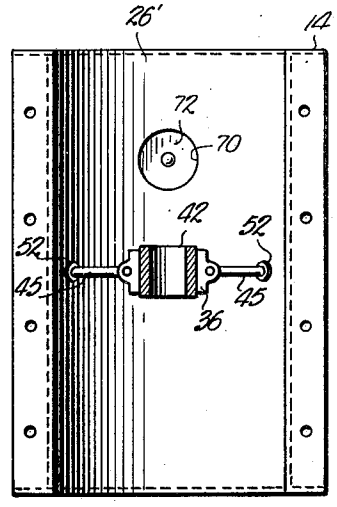


Fig. 9.

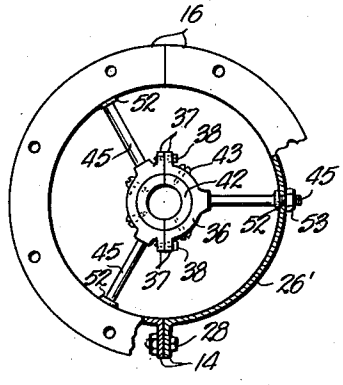


Fig. 8.

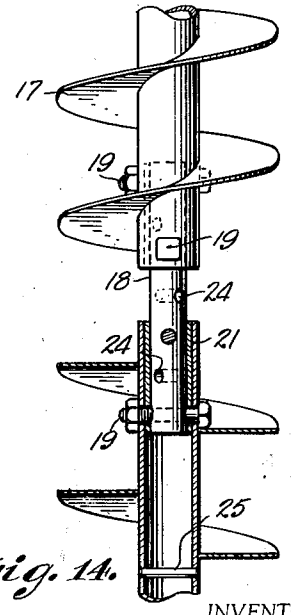


Fig. 14.

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UNITED STATES PATENT OFFICE

2,360,776

ELEVATING APPARATUS FOR HANDLING BULK MATERIALS

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Application November 21, 1941, Serial No. 419,812

9 Claims. (Cl. 198—213)

The present invention relates to elevating apparatus and aims to provide improvements for greatly promoting and increasing the efficiency of vertical conveyor mechanism of either the helicoid or the screw conveyor type.

Inasmuch as conventional elevating apparatus of the type designated has not been of a character adapted for efficient operation over more than a comparatively limited height range, an important object of the present invention is to increase very materially that range, as well as the speed and capacity thereof, by virtue of improvements providing bearing means for effectively supporting the conveyor mechanism at the required intervals throughout the height of the apparatus.

For carrying out this primary purpose of the invention we provide bearing structures adapted for installation at the various joints of a sectional screw (or helicoid) conveyor apparatus of the vertically operating type, and include provision for affording means for suitable inspection and maintenance services, and in some cases also enabling replacements to be carried out in a convenient and effective manner.

Accordingly the proposed improvements may take the form of either sectional or non-sectional or what may be termed solid bearing assemblies adapted for installation at the joints between the sections of the conveyor housing and which latter may also be of either a solid or split type, by which is determined to some degree the type of bearing assembly to be installed at the respective joints between the sections of the apparatus.

It is further sought to provide a novel and adaptable form of junction means between the apparatus and its feeding mechanism, as well as practical and flexible arrangements of driving means for operating the conveyor mechanisms of the apparatus.

The characteristics of the invention will therefore be described in more detail by reference to typical forms of construction suitable for embodying our proposed improvements, as illustrated in the accompanying drawings—after which those features and combinations which are deemed to be novel and patentable will be particularly set forth and claimed.

In the drawings—

Figure 1 is an elevation illustrating elevating apparatus of the vertical conveyor type and embodying bearing assemblies and connections of the character proposed by the present invention;

Figure 1*a* is an elevation of the lower portion of said apparatus and viewed at right angles to Figure 1;

Figure 1*b* is an enlarged sectional detail of the top or discharge portion of said apparatus;

Figure 2 is a sectional elevation on an enlarged scale, showing one of the bearing assemblies, together with the split housing or junction sections therefor by which connection is made with the adjoining conveyor housings;

Figure 3 is a separate plan view of the bearing structure in detached relation;

Figure 4 is a view similar to Figure 2, but showing what is referred to as a non-sectional or solid type of bearing structure such as may be employed between sections of a conveyor comprised of only two sections;

Figure 5 is a separate plan view of said solid or non-sectional bearing structure;

Figure 6 is a view similar to Figure 1, showing a modified form of bearing assembly comprising both split bearing and split housing sections for connecting conveyor housing sections;

Figures 7 and 8 are elevation and plan views, similar to Figures 2 and 3 respectively, illustrating said modified form on an enlarged scale;

Figure 9 is a vertical sectional view of the parts appearing in Figure 7;

Figure 10 is an elevation of a modified form of apparatus suitable for embodiment of the improvements but with a different drive arrangement as hereinafter explained;

Figure 10*a* is a similar view, but looking at right angles to the plane of Figure 10;

Figure 11 is an elevation of the lower portion of an apparatus showing still another and different form of drive arrangement;

Figure 11*a* is a similar view but looking at right angles to the plane of Figure 11;

Figure 12 is a sectional plan view of the form of feed connecting unit shown in Figures 1 and 11;

Figure 13 is a horizontal sectional view, representing a section taken on the line 13—13 of Figure 12; and

Figure 14 is a detail and fragmentary view of the connections between coupled ends of the conveyor for enabling the carrying out of the maintenance and repair operations.

While various arrangements of screw type conveyors have heretofore been employed in vertical operating position, such practice has been of a somewhat limited character and also restricted to a comparatively limited height range as well as to relatively low speeds because

of the lack of any provision for proper bearing supports for the conveyor mechanism at appropriate intervals between the upper and lower ends of the apparatus. In operation (above any but relatively low speeds) such apparatus would exhibit considerable deflection from vertical, not only at the joints between sections of the conveyor but also at other points where sections of any considerable length of both conveyor and housing are used—such deflection of course resulting from the rotative movement of the conveyor and the centrifugal force developed therein. Moreover when this apparatus would be operated at intervals without load, the outer edges of the conveyor flighting (or screw) would actually be deflected outward into rubbing engagement with the inside of the conveyor housing or casing, with disagreeable noise and very objectionable wear and tear as well as power losses and heat developed by the friction.

Besides the aforesaid limitations and disadvantages, a factor which has prevented the vertical type of installation from meeting with wider favor and more extended adoption and use has been the necessity for in most cases completely preassembling the units of the apparatus in a horizontal position and thereafter upending the assembled construction into vertical operative position at the place of installation.

Now there are important advantages inherent in the vertical operation of conveyor mechanism of this type as hereinafter pointed out, provided the aforesaid objectionable features are satisfactorily overcome or eliminated, and the object of the present invention is to eliminate such drawbacks and disadvantages characterising previous types of apparatus of this general vertical design. This purpose is accomplished by providing a construction of relatively shorter conveyor and housing sections, together with efficient bearing structures at the connections between the sections for affording all necessary support for the conveyor and effective reinforcement for the apparatus when assembled and ready for operation, thereby resulting in a very materially higher operative speed and correspondingly increased capacity.

These various improvements are also of such a nature as to make all necessary provision for convenient inspection and efficient maintenance of the bearing assemblies and the connections between the various sections of the apparatus.

Referring now to the drawings in detail, and more particularly in the first instance to Figures 1 to 5, the improved construction is here illustrated as embodied in an apparatus composed of a plurality of lengths of conveyor casing or housing **15** which may be of split formation with longitudinal flanges **14** and end flanges **16** with the mating flanges secured together by bolts **20** (as more clearly illustrated in Figure 2); and within the assembled casings or housings operates a conventional type of screw conveyor **17** made up in sections of corresponding length coupled together at the joints between the lengths or sections of the conveyor housing **15**. Adjoining ends of the conveyor sections are coupled by means of short shaft sections or couplers **18**, bolts **19** and sleeve bushings **21** substantially as described in Patent No. 2,260,811, issued October 28, 1941—the said coupler sections **18** having openings **24** (see Figure 14) for coupler shifting purposes in the making of repairs in the manner explained in said patent.

Our preferred construction for the bearing assemblies and connections between the conveyor and housing sections of the apparatus—particularly where more than two such sections are involved—is illustrated in Figures 2 and 3. This construction comprises split housing sections **26** above and below the bearing member, these housing sections also having flanges **14** and **16** and bolts **20** and **28** for removably securing said split housing sections together as well as to the flanges **16** of the conveyor housings **15**.

The bearing member or unit, as illustrated in Figures 2 and 3, is also of split or sectional construction corresponding to the sectional or split form of the sections **26**, and comprises a ring-shaped plate member **30** of suitable gage and adapted to be embraced between the adjoining or mating flanges **16** of said sections **26** and provided with bolt holes **31** for the corresponding bolts **20**. This ring-shaped member **30** is made in half-sections fitted together with mating V-shaped ends **32** and recesses **34** in line with the vertical joints between the sections **26**, as shown in Figure 3. This ring member serves as a support for a bearing comprising a split bearing member **36** formed with lugs **37** provided with cooperating pointed pins **38** and recesses **40** for the accurate alinement of the bearing sections, within which is fitted a split sleeve bushing **42** held in place by means of anchoring screws **43**. This bearing structure is mounted and secured in place within the ring member **30** by means of a set of three radial spoke members **45** spaced equal angular distances apart and suitably secured, as by screw fitting at their inner ends to the bearing sections **36** and by welding of their outer ends within slots or recesses **46** in the ring member **30**. This anchoring is also carried out so as to aline the bearing split with the vertical joints between the sections **26**; and we find that the use of two radial supports at one side of said split line and a single radial support at the other side will afford a sufficiently secure and rigid supporting means which at the same time allows for a satisfactory clearance of the material past the bearing units.

The V-formation of the ends **32** and recesses **34** serves to centralize the bearing elements and also takes the strain off the pins **38** as the parts of the bearing structure are assembled together.

The bearing assembly illustrated in Figures 4 and 5 differs from that already described in that the ring member **30'** is shown as simply made of integral or one-piece construction, as are also the bearing members **36'** and the sleeve bushing **42'**—the remaining features of construction, including the manner of securing same by means of bolts **20** to the adjacent flanges **16**, being substantially the same as illustrated in Figures 2 and 3. Figure 4, however, illustrates the bearing unit as secured in place between the flange **16** of a split housing section and the corresponding or adjoining flange **16** of a solid conveyor housing or casing **15'** such as may under some circumstances be regarded as sufficient—as in apparatus comprising no more than say two units or sections.

With an apparatus constructed as above outlined it is apparent that all necessary provision is made for bearing support for the conveyor mechanism and for thereby effectively reinforcing the apparatus at the successive joints between the conveyor casings or housings, with the result that the same is properly stabilized throughout the height of the apparatus. By thus maintaining an efficient stabilizing means

adequate for overcoming all objectionable deflecting tendency, we are able not only to operate the apparatus at much higher speeds than now practiced but are also able to obtain the various other advantages inherent in the vertical lift type of apparatus, such as economy in space and power, and the extension of the apparatus up to a height practically limited only by the torque capacity of the operating shaft. Obviously the radial load in such operations is comparatively less than for horizontal conveyor operations, and as a result somewhat less sturdy or rigid bearing structures may be employed in the assemblies forming the connections between the conveyor units, so that a more open structure is possible which allows wider clearance for the passage of the material past the bearings. In actual operation with most bulk materials adapted to be handled by conveyor mechanism of this type it is found that the present improved construction will at given speeds operate at capacities very closely approximating the cross-sectional load capacity of the conveyor mechanism. Moreover, this operation at a higher speed in practice causes the material to be elevated in a more uniform stream, and a stream of relatively smaller cross-section is required for producing the desired greater capacity.

Since different materials are often required to be handled in different operations, it is objectionable to have any material left in the conveyor between successive operations, and in this respect the higher rate of operation of the present improved construction is particularly advantageous because of its completely evacuating the material following each and every operation, by a brief running period after the feed of the material thereto is cut off—so that the conveyor apparatus is thereby rendered practically self-cleaning. This is likewise a power-saving factor because of its elimination of the greater starting-power requirement involved in present conventional forms of apparatus, in which the lower speed of operation always leaves more or less material behind in the conveyor, so that an abnormal power demand is thereby created for the purpose of starting the apparatus anew, due to the greater initial static load.

In all types of installation of the apparatus it will be understood that suitable feeding and discharge units will be associated with the lower and upper ends of the apparatus. Varying conditions may of course require somewhat different types of installation.

In Figures 1 and 1*a* is illustrated an arrangement which includes a bottom or base drive unit **50** having connections **52** to a suitable motor **54**, as well as drive connections **55** for actuating a feeder assembly, which in turn comprises an appropriately supported feeder casing **56** for a feeder conveyor **57** having the opposite ends of its shaft **58** journaled in bearings **59** and **60**. The bearing **60** is provided as part of a junction box or unit **62** having top and bottom flanges **16** for connection with the lower end of the bottom conveyor housing **15** or **15'** and also with an adapter unit **66** mounted on top of the base driving unit **50**.

The junction box or unit **62** is formed with a symmetrically arranged and offset L portion **68** as illustrated in greater detail in Figures 12 and 13, whereby the horizontal feed conveyor **57** is adapted to discharge into said junction unit a little to one side of the axis of the vertical conveyor **17** (at the lower end thereof), and the symmetrical design permits the adjustment of said unit **62** into different operative relations, as for either right or left hand feed—as represented by the contrasting relations illustrated in Figures 1 and 12.

The junction box or connecting unit **62** is preferably provided (on the side opposite its L portion **68**) with an inspection and clean-out opening **70** which is normally closed by a cover plate or disk **72** removably secured in place by means of a spring latching element **73** the ends of which are adapted to engage notches or recesses in a pair of lugs **74** projecting out at opposite sides of said opening **70**, as clearly illustrated in Figure 13.

At the upper end of the apparatus a discharge unit is provided in the form of a casing section **75** adapted to be secured to the top conveyor housing section **15** and also provided with a cap member **76** equipped with a conventional end thrust bearing unit **77** for the upper end of the conveyor **17**. The discharge casing **75** has an outlet opening **78** to which any desired type of discharge connection, such as indicated at **79**, may be attached; and adjacent to said opening **78** is provided a safety or overflow outlet **80** which is normally closed by a hinged flap or gravity closure member **81**. The upper end of the conveyor **17** may also be provided with a paddle blade **82** which rotates with the conveyor and thereby operates to set up and maintain a circulatory movement of the material in the direction of the discharge outlet opening **78**—all as illustrated in Figure 1*b*.

The use of split housing sections **26** in connection with the bearing units is an important factor in connection with the inspection of the bearing and coupling means and servicing of the same—the removal of certain of the bolts **20** and **28** permitting one section to be removed and replaced at a time, either above or below the bearing; and the split form of the bearing also enables it to be disconnected and removed for repairs, and provides access to the coupling elements **18** whereby conveyor sections may be uncoupled for servicing or maintenance (as explained in the Patent #2,260,811 referred to in the foregoing). In this operation, the conveyor being vertical, we also provide a stop pin **25** in the conveyor section below the bearing to limit the drop of the coupler on removal of the bolts **19**.

Moreover the use of the split housing sections **26** provides for self-supporting of the conveyor sections as the housing sections are alternately removed and replaced; and obviously the use of split housing sections both above and below the bearing elements very greatly facilitates the removal and replacement of the conveyor sections where the conveyor housings or casings are also split, as in the case of the upper conveyor housings **15** as illustrated. The use of split housing sections above and below the bearing elements in the same manner is also of a distinct advantage in enabling the use of the solid type of bearing elements shown in Figures 4 and 5, when desired.

It will also be understood that the invention contemplates the use of the split type of housing sections **26** with either the solid or non-sectional form of bearing structure (Figure 5) which allows inspection of the condition of the parts, or the sectional form of the bearing (Figure 3) which facilitates both inspection and maintenance of the parts. Moreover it is contemplated that either type of bearing element may be com-

bined with the split housing sections in conjunction with either the solid or split type of conveyor housings or casings **15** or **15'**.

Referring now to Figures 6 to 9, these views illustrate the use of split housing sections **26'** for the connections between the ends of adjoining conveyor housings **15'** and the attachment of the split bearing assemblies directly to the interior of those housing sections instead of providing a sectional ring structure to be inserted between sections of the apparatus independent of said sections **26'**. As may be seen by a comparison of Figures 3 and 8, the parts of the bearing unit are attached to said sections **26'** in the same cooperative relation as in the case of the split ring sections **30**, with the exception that the ends of the spoke elements **45** are preferably provided with fixed collars or washers **52** and nuts **53** for rigidly securing or anchoring said spoke ends to said housing sections **26'**. This modified form of construction is suitable for some types of installations but is less generally adapted, since the bearing is made a fixed part of the housing structure and is repaired with somewhat more difficulty, so that greater care would be required in replacements as regards the proper alinement of the bearing parts.

It is particularly desirable in this type of construction to make proper provision for the inspection and cleanout operations, and this is readily carried out by providing substantially the same form of inspection and cleanout openings **70** and cover plates **72** as already referred to, either above or below, or both above and below the bearing **42**, as illustrated.

The views represented by Figures 10 to 11*a* of the drawings are simply for the purpose of illustrating the flexibility or adaptability of the improvements for varying drive arrangements and connections.

In Figures 10 and 10*a* the apparatus is illustrated as driven by means of a top drive unit **85** having a drive shaft **86** which may be actuated in any desired manner; and in such an arrangement any desired or modified form of junction unit—such as that indicated at **62'** for connection with a feeding unit—may be employed at the bottom of the apparatus, where it is supported by means of a step bearing member **88** (said feeding unit and its drive connections not being illustrated).

In Figures 11 and 11*a* the drive connection is also assumed to be made at the top of the apparatus, and the bottom section **90** is intended to represent a take-off drive unit for transmitting power from the conveyor for driving the feed mechanism through the intermediate drive connections indicated at **92**.

It may be remarked that in case the apparatus of Figures 10 and 10*a* were driven from the bottom (as is the case in Figure 1), then the drive section or unit **85** might obviously be utilized as a take-off drive unit for the driving of other adjoining units of the apparatus.

It will therefore be apparent that we have devised a novel, practical and highly efficient vertical lift type of apparatus for carrying out all the aforesaid objects of our invention, the same comprising a construction which, in addition to possessing all the above advantages, may also be readily installed without any pre-assembly of its parts, and is adapted for the handling of the usual character of materials (such as commonly handled by the various forms of bucket elevators) more economically by virtue of the operation being cleaner and requiring less power and space and thereby providing more room for storage purposes.

While we have illustrated and described forms of construction which have been tested and found practicable and suitable for the practice of our invention, we wish the same to be regarded merely as illustrative, with the understanding that we expressly reserve the right to make such changes or modifications as may fairly fall within the spirit and scope of our invention as defined by the following claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A vertical lift screw conveyor apparatus comprising a series of conveyor housing sections in vertical alinement, screw conveyor mechanism in sections matching said housing sections and enclosed thereby, and bearing assemblies and housing connections therefor comprising split casing structures removable and replaceable by direct transverse movement into and out of the spaces between adjoining ends of said housing sections and also correspondingly split bearing means within each of said casing structures for the corresponding ends of the sections of said conveyor mechanism.

2. A vertical lift screw conveyor apparatus comprising a series of conveyor housing sections in vertical alinement, relatively short split casings removably mounted between adjoining ends of said conveyor housing sections, screw conveyor mechanism enclosed by said housing sections and comprising sections matching said housing sections, and a bearing assembly mounted between each of said split casings and one of said conveyor housing sections and including a split bearing unit providing a bearing for the ends of the corresponding sections of said conveyor mechanism.

3. A vertical lift screw conveyor apparatus comprising a plurality of conveyor housing sections in vertical alinement, relatively short split casings removably mounted between adjoining ends of said conveyor housing sections, screw conveyor mechanism enclosed by said housing sections and comprising sections matching said housing sections, and a bearing assembly mounted between each of said split casings and one of said conveyor housing sections and including a correspondingly split bearing unit providing a bearing structure for the ends of the corresponding sections of said conveyor mechanism.

4. A vertical lift screw conveyor apparatus comprising a plurality of conveyor housing sections in vertical alinement, screw conveyor mechanism in sections matching said housing sections and enclosed thereby, split bearing assemblies providing bearings for adjoining ends of the sections of said conveyor mechanism, and a relatively short split casing removably mounted between each of said bearing assemblies and each of the ends of the corresponding housing sections.

5. A vertical lift screw conveyor apparatus comprising a plurality of conveyor housing sections in vertical alinement, split casings connecting adjoining ends of said housing sections and being removable and replaceable by direct transverse movement into and out of the spaces between said housing sections, screw conveyor mechanism in sections matching said housing sections and enclosed thereby, and split bearing assemblies forming part of the connections between adjoining ends of said conveyor housing sections and including radial spoke members

supporting bearing elements for corresponding ends of said conveyor mechanism.

6. A vertical lift screw conveyor apparatus comprising a series of cylindrical conveyor housing sections in vertical alinement, screw conveyor mechanism in sections matching said housing sections and enclosed thereby, and combination casing on bearing assemblies removably mounted between adjoining ends of said housing sections, each of said assemblies including a split or sectional ring member removably secured between said adjoining ends and a correspondingly split or sectional bearing for the adjoining ends of said conveyor sections.

7. A vertical lift screw conveyor apparatus comprising sections of cylindrical conveyor housing in vertical alinement, screw conveyor mechanism in sections matching said housing sections and enclosed thereby, and a combination casing and bearing assembly connecting said housing sections and including a split or sectional ring member and a correspondingly split or sectional bearing for the adjoining ends of said conveyor sections and provided with radial spoke members connecting the bearing sections with corresponding sections of said ring member.

8. A vertical lift screw conveyor apparatus comprising sections of cylindrical conveyor housing in vertical alinement, screw conveyor mechanism in sections matching said housing sections and enclosed thereby, and a combination casing and bearing assembly removably connecting said housing sections and including a split or sectional ring member and a correspondingly split or sectional bearing for the adjoining ends of said conveyor sections, the sectional parts of said ring member having mating V-shaped projections and recesses cooperating to centralize the parts of the assembly.

9. A vertical lift screw conveyor apparatus comprising a plurality of vertically split conveyor housing sections in vertical alinement, relatively short and correspondingly split casings connecting adjoining ends of said housing sections, screw conveyor mechanism in sections matching said housing sections and enclosed thereby, and a bearing assembly also in correspondingly split sections associated with said split casings between said housing sections and including a split bearing unit providing a bearing for adjoining ends of said conveyor mechanism.

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