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;
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 and 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 fighting (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 suspending the assembled conveyor 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 operated the 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 coupled bolts 18 and sleeve bushings 21 substantially as described in Patent No. 2,360,711, issued October 28, 1941—the said coupled 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 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 26 and 18 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 flanging 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 to 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 35 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 bushes 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 securely 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 35. This anchoring is also carried out so as to align 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-formations 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 35' and the sleeve bushes 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 succeeding 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 a 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 operation, 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 1e 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 59 is provided as part of a junction by an offset section 61 and an adapter section 62 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 63 is formed with a smoothly curved 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-hand or left-hand feed representation 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 71 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 78, 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 79—all as illustrated in Figure 15.

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 whereby convey sections may be uncoupled for servicing or maintenance (as explained in the Patent 2,260,611 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 28.

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 3) 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 housing sections and the attachment of the split bearing assembly 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 10 and 11a, the parts of the bearing unit are attached to said sections 26' in the same co-operative 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 92 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 such arrangements as regards the proper alignment 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 11a 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 10a the apparatus is illustrated as driven by means of a top drive unit 85 having a drive shaft 68 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 90 (said feeding unit and its drive connections not being illustrated).

In Figures 11 and 11a 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 82.

It may be remarked that in case the apparatus of Figures 10 and 10a 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 conveyor apparatus, comprising a plurality of conveyor housing sections in vertical alignment, 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 alignment, 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.

3. A vertical lift screw conveyor apparatus comprising a plurality of conveyor housing sections in vertical alignment, 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.

4. A vertical lift screw conveyor apparatus comprising a plurality of conveyor housing sections in vertical alignment, 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 alignment, screw conveyor mechanism in sections matching said housing sections and enclosing thereby, 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 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 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.

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