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BELT ELEVATOR

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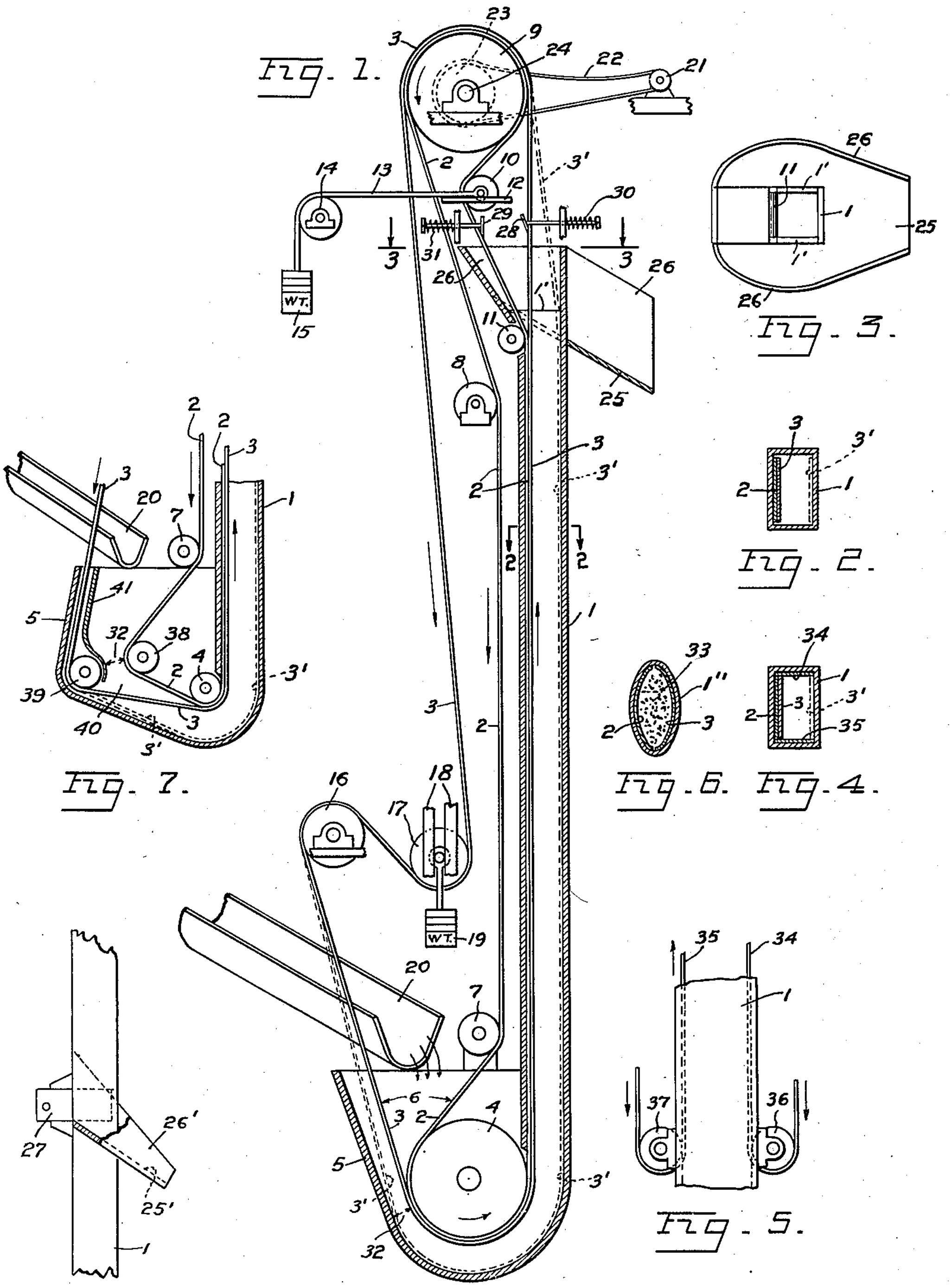

INVENTORS
Robert J. Cooper and
Edward D. O'Brien
BY [signature]
ATTORNEY.

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BELT ELEVATOR

Robert J. Cooper and Edward D. O'Brien, San Francisco, Calif.

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7 Claims. (Cl. 198—165)

This invention relates to the elevating of loose bulk material such as granular and powdered earths, cement, fertilizers, chicken and cattle feed, bran, crushed and whole grain, flour, dried fruits, raisins, sand gravel, and most any and all loose materials generally used in industry which require elevating in the course of manufacture, storing, shipping, or for any purpose whatever.

The principal object of our invention is to provide a novel method of elevating such bulk materials by means of embracing belts, together with simple apparatus for carrying out the method.

Special features and advantages of the invention will appear in the following description and accompanying drawing.

In the drawing:

Fig. 1 is an elevation of a vertical belt elevator made in accordance with our invention, and with the forward wall of the casing omitted to show the relation of the belts.

Fig. 2 is a cross section of the elevator casing of Fig. 1 at the line 2—2 of Fig. 1.

Fig. 3 is a cross section of Fig. 1 looking down as from the line 3—3 of Fig. 1.

Fig. 4 is a cross section similar to that of Fig. 2 but showing two additional belts in the casing.

Fig. 5 is an elevation of the lower portion of a casing as per Fig. 4 showing the manner of introducing the two additional belts.

Fig. 6 is a cross section of the elevator casing as at any intermediate point showing an oval form of casing.

Fig. 7 is an elevation of the lower part of a belt elevator showing a modified arrangement of belts, pulleys, and the material receiving boot from that shown in Fig. 1.

Fig. 8 is a fragmentary elevation of the elevator casing showing an intermediate discharge chute.

Before describing the drawing figures in detail it may be said that heretofore loose materials have generally been elevated by bucket elevators in which a series of buckets have been carried on belts, or chains, or individual articles such as newspapers, parcels, or lumps of dough for bread and roll making have been carried upward between a pair of belts urged toward one another by gravity or other means to grip the articles, such belts when overlying one another and running horizontally or at an angle generally being termed draper belts. Also gently inclined belt conveyors at moderate angles have been used to carry all sorts of loose materials, but of course the operative angles are limited to a few degrees in excess of the normal angle of repose of the respective materials, depending on the speed of the belt.

We have discovered, however, that if a pair of confronting belts, running upward in a tubular casing, is continuously fed with loose material at the lower end in a manner to urge the material between the belts so that they are forced apart more or less to the limits of the casing space, they will effectively lift the whole mass of loose material and continually discharge it from the upper edge of the casing or openings cut in its side walls, and that the lifting process will proceed at any angle or directly vertical to great heights. The belts may be perfectly smooth without cleats or attachments of any kind extending from their surfaces, so that for some classes of pulverulent materials tending to adhere or cake on the belts, scrapers or brushes may be freely used to aid in cleaning the belts at the point of discharge of the materials.

To provide a pair of ascending belts within an upwardly extending tube or tubular casing, quite a number of different arrangements of pulleys and idlers may be used, but for illustrative purposes merely, and without implying any limitations in this respect, three variations in arrangement of belts and pulleys are shown in the drawing, and also a modification in the form of the casing embracing the ascending belts and column of loose material.

In Fig. 1 of the drawing the vertically disposed casing is designated 1 and it is shown with its forward wall broken away to reveal the two upward running belts 2, 3 as in contact with one another and against the left hand side of the casing. These belts pass over a pulley 4 in a material receiving boot 5 similar to that of an ordinary bucket elevator, except that at the left side of the pulley the belts separate from one another to form a V-shaped material receiving space 6, it being understood that the width of the casing and boot is preferably just sufficient to clear the belts for most materials, though the belts may have considerable clearance from the casing at their edges and still effectually lift the load.

Belt 2 extends to the right and over an idler pulley 7, thence upward over another idler 8, thence around a head pulley 9, down around a slack take-up pulley 10, over another idler pulley 11 and back into the vertical part 1 of the casing.

Tension pulley 10 is indicated as movable along guides 12 and pulled back as by a rope 13 passing over a fixed idler 14 and provided with the desired number of weights 15, though this is only illustrative of any desired arrangement of tension carriage or slack take-up, and it is obvious that any adjustable spring tension may be used instead of the weights.

Belt 3 leaves the boot pulley 4 and passes upward at an angle to the left and over idler pulley 16, thence downward and around a slack take-up pulley 17, thence upward and over head pulley 9 in contact with belt 2, thence down into the casing 1 into contact with the vertical run of belt 2.

The slack take-up pulley 17 is shown as operating in guides 18 and loaded by suitable weights 19, but as explained for tension pulley 10, any of the well known slack take-up arrangements using weight or spring tension may be used, the only important thing to be observed is that the device be freely responsive so that belt 3 may quickly move away from belt 2 on pulley 4 to the dotted line position 3' as the material to be elevated is fed into the V space 6 between the belts in the boot 5 as from any suitable delivery spout or chute 20.

The belts may be driven as from a motor 21 or other suitable source of power by means of a belt 22 passing around a drive pulley 23 secured to the head pulley shaft 24, or by any desired arrangement of power transmission elements.

Just above idler pulley 11 the left casing wall is extended back to clear the angular run of belt 2 at that point and a downwardly slanted discharge chute 25 is secured to the casing. This chute has side walls 26 preferably embracing both sides of the casing, or in other words is wider than the casing as shown in plan in Fig. 3 and the two opposite sides of the casing stop at the bottom of the chute or a little above as at 1' so that material rising in the casing between the belts will freely fall to either side out of the casing into the chute for discharge from the end thereof. It is evident that but one side of the casing may be cut away for the material to come out of one side only into the chute if desired, or that with the elevator casing 1 extending up several stories such a discharge chute as at 25—26 could be provided at the different floors where it was desired to take off material, and suitable closures provided for the discharge opening in the side of the casing where no discharge was desired. Such a chute and closable opening in the casing is indicated in Fig. 8 of the drawing where the discharge chute is designated 25', its side walls 26', and a sliding gate in the side of the casing 1 is designated 27.

It is to be noted that as the loose material to be elevated is continuously delivered to the boot space 6 the outer belt 3 backs away from belt 2 more or less to the position 3' against the outer wall of the casing, and a solid column of the loose material rises in the casing between the separated belts, and that the normal tendency of the belts (on account of their mounting described) is to move toward each other to snugly embrace the material from opposite sides.

As some classes of material, such as dry lime, cement, flour, etc. tend to stick somewhat to the belts, resiliently pressed scrapers may be applied to one or both sides of the belts at points adjacent the discharge of the material. A pair of such scrapers is shown at 28 and 29 as urged against the belts by springs 30, 31.

A feature to be noted is that the space between the belts and the outer wall of the boot is preferably restricted at 32 so as to be somewhat less than the space beyond that point into and including the vertical column in the casing. This restriction forms a better seal against reverse movement of the ascending column of material should the character or feed of additional material into the boot not be constant enough to maintain the column entirely filled as is required.

In practice, when handling dusty materials, the feeding chute 20, and also the boot 5 are closed on top, insofar as the entering and leaving belts will permit, as is common practice in bucket elevators and other bulk material elevators, but for non-dusty materials open construction may be used. The casing 1 is of course closed on all sides and smooth inside to reduce any tendency to wear the belts.

Instead of the casing being rectangular as shown in Fig. 2, it may be of oval cross section as shown in Fig. 6 at 1'' and wherein the belts 2 and 3 are shown as spread apart and curved to the form of the casing and almost entirely embracing a column of loose material 33.

In the modification shown in Figs. 4 and 5 an additional pair of belts 34 and 35 is provided in a rectangular casing 1 so as to relieve the material being elevated from friction with the side of the casing. These belts are arranged to move upward at the same speed as belts 2 and 3 which are positioned freely between belts 34 and 35 for spreading apart to receive the load. Belts 34 and 35, of course, always remain against the opposite side of the casing as shown in Fig. 4. These additional belts when used will of course only be on the upright run of the casing from the boot upward, and they may pass over guide pulleys at both the lower and upper end as indicated for the lower end in Fig. 5 and wherein these guide pulleys are designated 36 and 37 and are shown as operating through suitable apertures in the wall of the casing. These belts may be independently driven at the same speed as the belts 2 and 3, or they may be suitably driven by any desired power transmission link from the head shaft 24. The use of such additional belts forms an ascending column of material entirely embraced on all four sides with a moving surface and thus dispenses with any casing friction which might tend to retard the material.

Fig. 7 shows one of the various modifications in arrangement of the belts in the material receiving boot. In this showing, the belts 2 and 3 are numbered the same as before and are supposed to be equipped with the same drive and take-up pulleys as shown in Fig. 1. In the boot, however, the arrangement is somewhat different as an additional pair of idler pulleys 38 and 39 are provided besides the usual lower pulley 4, to open up a substantially horizontally disposed converging space 40 for the entering material to force the outer belts 3 away from the inner belt 2 and a guard plate 41 is provided to shield belt 3 and pulley 39 from the incoming material from delivery chute 20, and also to form the restricted space 32, the function of which has already been described in connection with Fig. 1.

From the preceding description the operation of the apparatus will be thought sufficiently clear, but it may be stated that the tubular casing 1 may extend at any angle from the horizontal to perfectly vertical position and that as long as the delivery is maintained to the boot in sufficient quantity to keep the lower part of the casing substantially full the material will rise en masse substantially with the speed of the belts, even though the upwardly extending tubular casing itself is not kept entirely full, but to what height the material will rise has not thus far been determined for various classes of materials. The speed of the belts, and distance between belts in the casing when separated by the material, as well as the nature of the material are all factors which have an effect on the capacity of the system.

We are, of course, aware of the various draper belts and similar devices for elevating unit articles between them, but we are not aware of any attempt having been made before to elevate loose bulk materials, including finely powdered materials through the aid of a pair of belts, and while from the experiments thus far made the efficiency seems surprisingly great for so simple a construction, our invention does not preclude the use of transversely ribbed belts or similar artifices if desired, though from our tests thus far made we see no advantage in such additions and they interfere with the proper scrapping or brushing off of the material as is desirable with certain grades of material above the point of discharge.

At the end of the days work, when the feed to the boot is stopped the ascending column will not rise, and in most cases will fall back into the boot, and even get behind the two belts as they come together. However, in such cases when starting up again most or all of the material will be gradually forced into the ascending position again as before, depending on the rate of feed at the lower end. When desiring to carry out the last bit of material in the column at the end of the run, this may easily be accomplished by throwing in an armful of waste or other soft fibrous material which will act as a wad or plug under the column and carry the remainder of it entirely out to the point of discharge, and at which point the scavenging wad may be easily separated from the material. Such a wad might be a small sack of oats of a size to nicely fill the space between the belts, or even a rubber bag of the same size pumped up with air, and a half dozen of which devices may be kept on hand for the purpose.

The words tube or tubular casing as may be used herein and in the claims in designating the upstanding portion of the casing housing the ascending column of material, unless otherwise qualified include a tube which is square, oblong, oval or any other shape in cross section.

Having thus described our invention, some of its possible modifications and the manner of its operation, it will be seen to be capable of numerous variations in detail as may fall within the scope of the invention and our appended claims.

We therefore claim:

1. In a belt elevator, an upwardly extending tubular casing, a pair of confronting belts in said casing, means moving both belts upwardly, and means for feeding loose bulk material between the belts at the lower end of the casing and form a rising column of material between the belts, at least one of said belts being slack and provided with resilient take-up means permitting the belts to move apart relatively to opposite walls of the casing, the means for introducing the material between the belts including a boot at the lower end of the casing, a pulley in the boot over which both belts pass, and from which they diverge within the boot to receive the material between the diverging runs of the belts, said boot formed to provide a somewhat restricted passage for the entering material adjacent where the material first spreads the belts apart of lesser cross sectional area than the passage in the tubular casing.

2. In a belt elevator, an upwardly extending tubular casing, a pair of confronting belts in said casing, means moving both belts upwardly, and means for feeding loose bulk material between the belts at the lower end of the casing in quantity to spread the belts apart as permitted by the casing, and form a rising column of loose material of substantial cross-section between the belts, and means resiliently permitting the belts to separate to the opposite walls of the casing in embracing said column of loose material, said casing provided with a discharge opening at the side wall adjacent the edges of the belts for the elevated material.

3. In a belt elevator, an upwardly extending tubular casing, a pair of confronting belts in said casing, means moving both belts upwardly, and means for feeding loose bulk material between the belts at the lower end of the casing in quantity to spread the belts apart as permitted by the casing, and form a rising column of loose material of substantial cross-section between the belts, and means resiliently permitting the belts to separate to the opposite walls of the casing in embracing said column of loose material, said casing provided with a discharge opening at the side wall adjacent the edges of the belts for the elevated material and a discharge chute embracing said side wall to receive the discharged material.

4. A belt elevator comprising an upwardly extending tubular casing, a pair of endless belts with confronting reaches passing through said tubular casing, an elevator boot at the lower end of said tubular casing forming a closed continuation thereof, a pulley within said boot under which both belts pass directing said belts from spaced to converging relation and to said casing, means resiliently permitting said belts to spread apart, said casing and boot being of a size to permit substantial spreading apart of said belts, a driving head pulley over which both belts pass for moving both belts upwardly in said tubular casing, means for feeding loose bulk material between the converging portions of said belts in said boot in quantities sufficient to spread the belts apart and form a rising column of substantial cross-section of such loose bulk material between the belts within said tubular casing, and means for discharging elevated material from said casing before reaching said head pulley.

5. In a belt elevator, an upwardly extending tubular casing, a pair of confronting belts in said casing, means moving both belts upwardly, and means for feeding loose bulk material between the belts at the lower end of the casing and form a rising column of material between the belts, at least one of said belts being slack and provided with resilient take-up means permitting the belts to move apart relatively to opposite walls of the casing, the means for introducing the material between the belts including a boot at the lower end of the casing, a pulley in the boot over which both belts pass, and from which they diverge to receive the material, said boot provided with a guard plate across one of the entering belts and formed to provide a somewhat restricted passage for the entering material adjacent where it first spreads the belts apart

of lesser cross sectional area than the passage in the casing.

6. In a belt elevator, an upwardly extending tubular casing, a pair of confronting belts in said casing, means moving both belts upwardly, and means for feeding loose bulk material between the belts at the lower end of the casing in quantity to spread the belts apart as permitted by the casing, and form a rising column of loose material of substantial cross-section between the belts, and means resiliently permitting the belts to separate to the opposite walls of the casing in embracing said column of loose material, said tubular casing being of curved cross section so as to curve the belts to concave confronting relation when embracing the loose material.

7. In a belt elevator, an upwardly extending rectangular tubular casing, a pair of confronting belts in said casing, means moving both belts upwardly, and means for feeding loose bulk material between the belts at the lower end of the casing in quantity to spread the belts apart as permitted by the casing and form a rising column of loose material between the belts, and an additional pair of upwardly moving belts at the opposite walls of the casing in contact with said column of loose material.

ROBERT J. COOPER.
EDWARD D. O'BRIEN.