SELF-CLEANING ELEVATOR BOOT DEVICE
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This invention relates in general to apparatus for elevating and conveying material and more particularly to a bucket elevator incorporating a self-cleaning boot device.

In the operation of a bucket elevator it is frequently necessary to remove all material from the elevator to prevent contamination due to retention of spilled material for an excessive period of time and to prevent mixing between successive batches of different materials transferred by the elevator. Spillage of material from within the individual buckets of an elevator into the boot port is often accompanied by considerable difficulty in the prevention of contamination during elevator operation. Spillage is particularly difficult to control in the case of rubber paddles or the like which, because of the resiliency of the material, are more likely to spill from the bucket due to vibratory movement within the elevator. Such spillage is detrimental to the operation of the elevator.

A further object of the present invention is to provide a bucket elevator that is adapted to prevent spillage from the individual buckets mounted for orbital movement upon the endless carrier of an elevator.

Still another object of this invention is to provide a bucket elevator incorporating a moving seal that is operable in response to movement of the buckets to prevent spillage of material into the boot portion of the elevator.

Still a further object of the invention is to provide a conveying and elevating device wherein a belt conveyor feeds material to a bucket elevator and additionally functions to prevent contamination of material subsequently introduced to the device by eliminating spillage from loaded buckets into the elevator boot.

Another object of the present invention is the provision of a self-cleaning bucket elevator wherein an endless sealing belt is disposed for sealing engagement with the lips of the buckets and is movable in response to frictional contact with the buckets to maintain its sealing relationship with the leading edges of the individual buckets in the loading section of the elevator and to thereby prevent spillage therefrom.

Another object of the invention is to provide a bucket elevator of the above mentioned type wherein the sealing belt is supported in a manner to automatically maintain relatively high tensile relationship between the individual buckets and the belt.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification, and in which like reference characters are employed to designate like parts throughout the same,

FIGURE 1 is a perspective view of a bucket elevator incorporating one embodiment of the present invention,

FIGURE 2 is an enlarged fragmentary view, partly in section, showing the boot portion of the bucket elevator of FIG. 1,

FIGURE 3 is a fragmentary view of a bucket elevator showing modification of the device illustrated in FIG. 2,

FIGURE 4 is a fragmentary illustration, partly in section, of a further modification of the bucket elevator assembly of FIG. 1, and

FIGURE 5 is a cross-sectional view taken on lines 5-5 of FIG. 2.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention, and first particularly referring to FIG. 1, the bucket elevator generally indicated by reference numeral 10 comprises a housing 11 having a head section 12 and a boot section 13. A rotatable head shaft 14 and a rotatable foot shaft 16 are mounted in the head section 12 and boot section 13, respectively. The shaft 14 is driven by suitable means, not shown.

An endless carrier 17 is mounted for orbital movement within the housing 11 over pulleys 18 and 19 mounted on the shafts 14 and 16, respectively. It will be understood that the foot shaft 16 may be vertically adjustably mounted, as seen in FIG. 2. A plurality of spaced buckets 20 are mounted upon the carrier 17 to be carried thereby in an orbital path between the head pulley 18 and the foot pulley 19.

A material discharge chute 22 is formed at the head section 12 of the housing 11 and the boot section 13 is provided with an inlet chute 23 through which material may be introduced to the elevator 10. Material conveyed from the boot section 13 to the head section 12 is discharged by gravity into the chute 22 as the buckets 20 pivot about the head pulley 18 and the discharged material passed down the chute and through the discharge port 25. The housing 11 is shown as comprising a plurality of sections 26. These sections 26 may be formed of sheet metal or the like and are held together by suitable fastening means.

Material deposited into the inlet chute 23 is guided into the buckets 20 by guide plates 27 which are mounted on the inner walls of the housing 11 at each side of the path of movement of the buckets 20 to provide a minimum operating clearance between the buckets and the guide plates. Additionally, the lower portion of the inlet chute 23 is offset inwardly of the end wall of the housing 11 to provide a material guide 28 having a minimum operating clearance with the lips 29 of the buckets 20 as they move past the inlet chute. It has been found, however, that some spillage of material into the boot section 13 will occur and that such spillage, if uncorrected, will be detrimental to the operation of the elevator, as hereinabove stated. This spillage into the boot section 13 is eliminated by the self-cleaning device of the present invention.

In FIG. 2, the buckets 20 are shown in an enlarged view mounted upon the carrier 17 for movement through an orbital path within the boot section 13 around the foot pulley 19. The foot shaft 16 is adjustably mounted on the boot section 13 by takeups 30 for movement in a vertical direction to maintain proper tension in the carrier 17.

The self-cleaning device of the present invention is indicated generally by the reference numeral 31 which comprises guide pulleys 34 and 35 and a takeup pulley 36, all of which are mounted on the boot section 13. The pulleys 34 and 35 are mounted upon brackets 37 which protrude from the end wall of the boot section 13. The takeup pulley 36 is mounted inside of the boot section 13 and is horizontally spaced from the pulley 35. An endless sealing belt 38 is trained over the pulleys 34, 35 and 36.

The pulleys 34 and 36 are so positioned that the belt 38 moving between these pulleys is engaged by the lips 29 of the buckets 20 as they move through the boot section 13. It will be noted that the arc through which the belt 38 and bucket lips 29 are engaged is approximately 90 degrees. The pulley 35 is positioned to guide the return run of the belt 38 in spaced relationship with the path of engagement between the belt and the bucket lips 29. The
engagement between the sealing belt 38 and the bucket lips 29 provides a seal which will prevent material which has been deposited in the chute 23 from spilling into the bottom of the boot section 13. The belt 38 is driven upon the pulleys 34, 35 and 36 by means of the frictional contact with the bucket lips 29. In order to maintain the aforementioned frictional contact, movement of the belt 38, the takeup pulley 36 is mounted on a takeup assembly 40 for movement of the shaft 41 of the pulley in a direction to increase the length of the belt path. The counterweight assembly 40 comprises a pair of bell crank members 43 mounted on opposite sides of the boot section 13 and having weights 44 mounted upon corresponding legs thereof. The corresponding end portions of the other legs of the bell cranks 43 rotatably support the opposite ends of the shaft 41 of the pulley 36. It will be seen that the weights 44 are suspended by the bell cranks 43 at a location to cause the latter to pivot at points 48 in a direction to move the pulley 36 away from the pulley 37. The generally crescent shaped slots 45 are formed in boot section 13 to permit free movement of the shaft 41 and its pulley 36.

In operation, as the material to be conveyed is deposited from a suitable hopper or like device through the inlet chute contamination between successive batches thereof to the material discharge port 25 at the top of the elevator 10. Due to the construction of the elevator 10 and the vibration caused in the operation thereof, a portion of the material will spill from the buckets 20. This material falls downwardly upon the belt 38. The belt 38 is dimensioned so that it extends between the side walls of the boot section 13 to prohibit material from falling between the edges of the belt and side walls. It will be understood that the belt 38 may be formed with flanges at its opposite side edges (not shown) to provide a trough into which the material spills. The belt shown in FIGS. 2, 3 and 4 is a substantially flat belt, which is less expensive and as efficient as required in most applications.

Since the belt 38 is maintained in frictional contact against the lips 29 of the buckets 20, any material which falls upon the belt 38 will be deposited in next successive buckets moving in the orbital path. It is apparent that none of the material will fall to the floor of the boot section 13 to adversely affect the operation of the elevator 10. Due to improved operation provided by the self-cleaning device 32 of the present invention, different types of material may be conveyed without bringing about considerable contamination between successive batches. FIGURE 3 shows a modification of the assembly of FIG. 2 wherein corresponding reference characters have been employed to designate like parts. In the arrangement shown in FIG. 3, the shaft 41 of the pulley 36 is mounted for rotation about a fixed axis and a fourth pulley 49 is mounted above the pulley 36. This arrangement provides an increased arc of contact between the belt 38 and the lips 29 of the buckets 20. In FIG. 3 the shaft 50 of the pulley 49 is rotatably supported at its opposite end portions by a pair of levers 51 that are mounted on brackets 52 for pivotal movement about an axis 53. Weights 54 are mounted on the opposite ends of the levers 51 to urge the levers to move in a direction to increase the distance between the pulleys 49 and 36. The shaft 50 of the pulley 49 protrudes through crescent shaped openings 55 in the opposite sides of the boot section 13. It follows that the drive belt 36 will be maintained in the belt 38.

FIGURE 4 is a further modification of the bucket elevator of FIG. 1 wherein like reference characters have been employed to designate like parts. In this embodiment the material is deposited into the buckets 20 by means of a belt conveyor 69 employing a belt 70. The conveyor belt 70 is essentially an extension of the sealing belt 38 shown in FIGS. 1, 2 and 3. The takeup pulley 36 is replaced by a pulley 71 that is located outside of the boot section 13 at any desired position in horizontally spaced relationship to the pulley 72. The pulley 72 corresponds to the pulley 35 of FIG. 2 but is mounted with its axis 73 rotatably supported by takeups 74 which are operable to adjust the position of the pulley 72 toward and away from the pulley 71.

A suitable hopper 75 is provided at the outer end of the belt conveyor 69 to receive and deposit material onto the belt 70 and skirts 76 prevent spillage of material from the belt. A plurality of spaced idlers 77 support the load carrying and return runs of the belt 70.

Material deposited in the hopper 75 is carried by the belt 70 into the elevator 10 and will be picked up by the buckets 20 for transport to the discharge port of the elevator. The belt 70 acts as both a conveyor and a sealing belt. Any material which is spilled from the buckets 20 and falls downwardly upon the belt 70 is picked up by successively following buckets moving through the orbital path upon the endless carrier 17.

It will be noted that in this embodiment of the invention, the pulley 75, which corresponds to the pulley 34 of FIG. 2, is driven by means of a power takeoff member from the foot shaft 16. A chain 79 or other suitable flexible driving connection is provided between the rotating foot shaft 16 and the shaft 80 of the pulley 79. Although the pulley 79 in FIG. 4 is supported on the shaft 80, it may be drivingly connected to the pulley 75. When the bucket 20 is maintained, it is may be insufficient to drive the conveyor 69. FIGS. 4 and 5 show the chain 79 disposed upon the sprocket 81 carried by the foot shaft 16 to drive the pulley 78 through the sprocket 82 which is mounted on the shaft 80. It will be readily apparent that the sprockets 81 and 82 may be spaced apart to provide considerable speed which coincides with the speed of the lips 29 of the buckets 20.

The present invention provides therefore a self-cleaning bucket elevator wherein the lips 29 of the individual buckets 20 are spaced horizontally from each other during movement within the elevator so that they are sealed to prevent spillage by means of a frictional contact between the lips and an endless flexible sealing belt mounted over a plurality of pulleys disposed within the boot section 13 of the elevator. It will be understood that the sealing belt may comprise a portion of a belt conveyor adapted to feed material to the bucket elevator.

The device comprises generally an arrangement of pulleys and movable sealing belt disposed thereon wherein one or more of the pulleys is adjustable to provide a means for applying tension to the belt to maintain frictional relationship between the lips 29 of the individual buckets 20 and the flexible belt. In at least one embodiment of the present invention, the sealing belt is driven by means of an external force taken from the elevator. The power is preferably taken from the rotating foot shaft 16 of the elevator.

I have illustrated and described what I consider to be the preferred embodiments of my invention. It will be understood, however, that various alterations and modifications may be made without departing from the spirit of the invention and the scope of the subjoined claims.

Having thus described the invention, I claim:

1. In a bucket elevator including a plurality of buckets mounted for movement through an orbital path with the lips of said buckets facing outwardly from said path, and said housing enclosing said bucket path and having side walls adjacent opposite sides of said buckets and end walls adjacent the bucket lips, the improvement comprising an endless belt having its side edges arranged in juxtaposition with the side walls of said housing, a first pulley member mounted at the lower end of the orbital path adjacent one end wall of said housing, a second pulley member mounted adjacent the other end wall of said housing, said first and second pulleys supporting said endless belt for movement through a path across the lower portion of said housing and into engagement with the lips of the bucket moving through the lower portion of the orbital path to be solely guided by said lips to form the path of travel of the upper run of said endless belt in mov-
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5 ing through the lower portion of said housing, and means
applying tension to said belt to urge the latter into fric-
tional engagement with said lips and to cause said belt to move with the lips in response to said fric-
tional engagement, said engagement between said belt and
said lips preventing material from spilling from said buck-
ets and the movement of said belt across the lower por-
tion of said housing returning material thereon to said
bucket path for reintroduction to said buckets and re-
moval from said elevator.

2. Apparatus as refined in claim 1 further characterized
by means drivingly connecting one of said pulleys to said
buckets for synchronizing the movement of the belt and
bucket lips to prevent relative movement therebetween.

3. In a bucket elevator including a plurality of buckets
mounted for movement through an orbital path upon an
endless flexible carrier supported by rotating head and
foot shafts and enclosed by a housing, a pair of vertically
spaced pulleys mounted adjacent the lower end portion of
said orbital path at the side thereof through which the
buckets move upwardly, a third pulley mounted at the
opposite side of said path and horizontally spaced from
said housing, an endless flexible conveyor belt movably
supported by said first, second and third pulleys, said pul-
leys being positioned with respect to said orbital path to
maintain said belt in tension against the outer edges of
the buckets moving through the lower portion of the
orbital path with said belt being solely guided by said
outer edges to form the path of travel of the upper run
of said belt in moving through the lower portion of the
housing whereby the buckets pick up material from the
belt, said belt sealing the outer edges of the buckets during
initial upward movement thereof to prevent spilling of
material into the lower portion of the housing, and means
drivingly connecting the rotating foot shaft to one of said
pulleys to synchronize movement of said belt and the
edges of the buckets engaged thereby.

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