

Feb. 18, 1936.

A. A. HOLBECK

2,031,369

FEEDING APPARATUS

Filed March 23, 1935

2 Sheets-Sheet 1

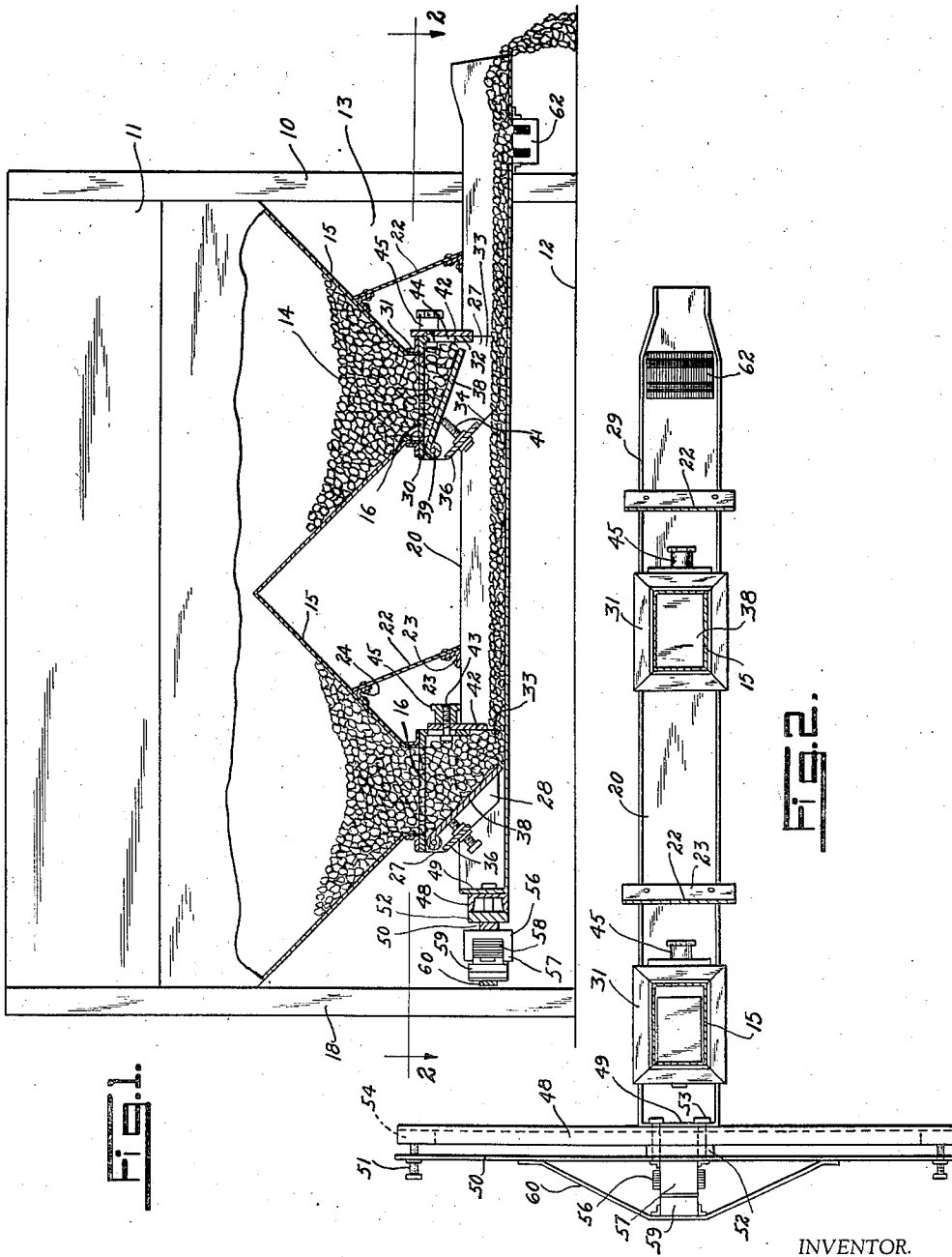


Fig. 1.

Fig. 2.

INVENTOR.

AUSTIN A. HOLBECK

BY

Kwis, Hudson & Kent.

ATTORNEYS

Feb. 18, 1936.

A. A. HOLBECK

2,031,369

FEEDING APPARATUS

Filed March 23, 1935

2 Sheets-Sheet 2

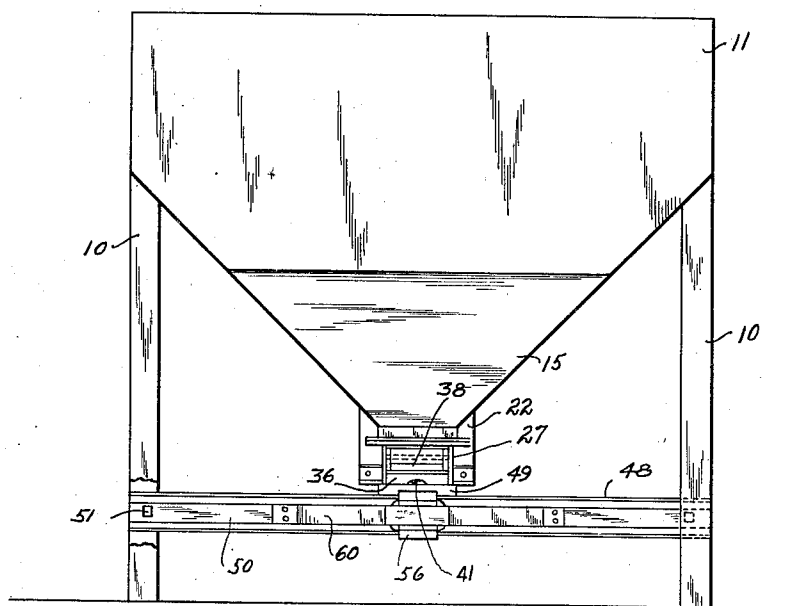


FIG. 3.

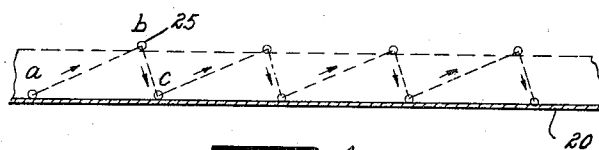


FIG. 4.

INVENTOR.

AUSTIN A. HOLBECK

BY

Kwis. Hudson & Hend.
ATTORNEYS

UNITED STATES PATENT OFFICE

2,031,369

FEEDING APPARATUS

Austin A. Holbeck, Long Lake, Mich.

Application March 23, 1935, Serial No. 12,665

5 Claims. (Cl. 198—220)

This invention relates to apparatus for feeding bulk material, and more particularly to apparatus of this kind which can be used for storing a supply of bulk material, such as coal, and feeding the same, as desired, to a pulverizing machine or other apparatus.

In apparatus for feeding bulk coal to a pulverizer or other machine, it is desirable to provide a hopper or container which will afford sufficient storage space for a given supply of coal, and also to be able to feed the coal, as desired, from the container to the pulverizing machine, which may be the pulverizing machine disclosed in my prior Patent No. 1,855,171, issued April 19, 1932. With the storing and feeding apparatus heretofore available, it has been necessary to increase the height of the container in order to increase the capacity thereof, and such increased container height is objectionable because of the increased distance through which the material must be lifted in filling the container, and also because the necessary space is not always available in furnace rooms where apparatus of this kind would be most frequently used. I have, therefore, devised improved storage and feeding apparatus wherein the height of a container, of the desired capacity, is maintained relatively low by providing the container with a plurality of discharge hoppers and by employing a vibratory trough feeder for delivering the material from the hoppers. With the arrangement which I have provided, a single trough conveyor delivers material from any number of hoppers with which the container may be provided, and permits the storage container to be located at any desired distance from the pulverizing machine.

An object of the present invention is to provide apparatus, for feeding bulk material, comprising a container provided with a plurality of discharge hoppers, and a vibratory trough conveyor to which material may be selectively fed from said hoppers.

Another object of the invention is to provide improved apparatus, for storing and feeding bulk material, wherein a relatively low multiple hopper container has a trough extending beneath the hoppers and wherein novel means is provided for selectively controlling the feeding of material from the hoppers to the trough.

Still another object of this invention is to provide apparatus, of the type referred to, wherein the control means of the hoppers includes a closure on the foremost hopper and means whereby such closure may be moved to a position rela-

tive to the trough to allow passage of material fed from a preceding hopper.

A further object of the invention is to provide improved feeding apparatus, of the type referred to, wherein a gate associated with each hopper regulates the depth of material being fed into the trough therefrom.

It is a further object of this invention to provide bulk storage and feeding apparatus, wherein a structure provides a container having a space therebelow and a plurality of hoppers depending into said space, each hopper having a discharge for delivering material to a trough, and wherein means is provided for selectively controlling the delivery of material from the hoppers including a closure hinged adjacent the rearmost edge of each hopper and means whereby the closure of the foremost hopper is adapted to be swung to a closed position above the bottom of the trough to permit passage of material fed from a preceding hopper, and wherein gate means on each hopper is adjustable relative to the bottom of the trough for regulating the depth of material being fed from the hopper.

Other objects and advantages of the invention will be apparent from the following description when taken in conjunction with the accompanying sheets of drawings, wherein

Fig. 1 is a side elevation with parts in section showing bulk storage and feeding apparatus embodying my invention.

Fig. 2 is a sectional plan view taken as indicated by line 2—2 of Fig. 1.

Fig. 3 is an end elevation of the apparatus, and

Fig. 4 is a diagrammatic view representing, on an enlarged scale, the movement of particles being fed by the trough conveyor.

In the accompanying drawings to which more detailed reference will now be made, I have shown improved apparatus for storing and feeding bulk material, and which is especially suitable for supplying bulk material, such as coal, to a pulverizing machine or other apparatus. It will be understood, of course, that the drawings are to be regarded only as illustrative of one embodiment of the invention defined in the appended claims.

The embodiment of my improved bulk storage and feeding apparatus which is illustrated in the drawings, includes a suitable structure or framework 10 for supporting a container 11 above a floor or foundation 12, with a space 13 between the bottom of the container and the floor. The container may have any desired shape such as the rectangular shape shown in this instance,

and may be of any size suitable to hold or store a desired quantity of bulk material 14, such as coal.

According to the present invention the bottom of the container 11 is constructed with a plurality of spaced hoppers 15 which depend into the space 13 and each of which has an opening 16 at the bottom thereof for discharge of bulk material. Although the hoppers may be provided in any number appropriate to the size or shape of the container 11, I show in this instance only two hoppers, which is sufficient for the purpose of disclosing the present invention.

The supporting structure or framework 10 may be of any suitable construction, for example, may have vertically disposed corner posts 18 formed of angle irons or any other suitable structural members. Similarly the container 11, including the hoppers 15 thereof, may be constructed from any suitable material, such as steel plates cut or bent to appropriate shape and suitably secured together and to the supporting structure 10. The top of the container may be left open so that the bulk material may be shoveled or dumped directly thereinto.

Beneath the hoppers 15 I provide a feeder for delivering material from the container at a desired rate, comprising a trough 20 mounted for vibratory movement. A portion of this trough extends into the space 13 and is disposed immediately below the hoppers 15 to receive material discharged through the opening 16. A portion of the trough also extends outwardly from beneath the container to deliver the material to any desired machine or point of use. The trough may be of U-like cross-section and may be constructed from steel plates or any other suitable material.

To enable the trough 20 to function as a feeder or conveyor I mount the same for vibratory reciprocating movement which causes the material to be advanced along within the trough. Various mounting means may be provided for this purpose, but in this instance I show the trough suspended from the container structure, preferably from the hoppers 15, by means of resilient metal plates 22.

These plates may be connected to the trough and to the hoppers in any suitable manner, such as by means of angle clips 23 and 24. The plates 22 may be provided in any number to properly support the trough for the desired vibratory movement, and in this instance I show one such connection between the trough and each of the two hoppers 15. As shown in Fig. 1 of the drawings, the resilient plates 22 are inclined with respect to the plane in which the trough extends so that during the forward stroke of the vibratory movement of the trough there is a tendency to lift the material, and upon the return stroke the trough moves quickly backward and downward leaving the material partly suspended. As this reciprocating vibratory movement of the trough is rapidly repeated, the material is caused to move or travel rapidly along within the trough.

The feeding action thus obtained by the vibratory reciprocating action is diagrammatically indicated in Fig. 4, which represents on a scale of approximately thirty to one, the path of movement of a particle 25 during reciprocation of the trough 20. It will be understood, of course, that the reciprocating movement of the trough itself will take place through only a very short distance or stroke, which may be in the neighborhood of

one thirty-second of an inch. During the forward movement of the trough the particle is lifted and advanced from the point *a* to the point *b* and during the time that the particle drops from the point *b* to the point *c* the trough is moved backward to its starting position. During the succeeding vibratory reciprocations of the trough this movement of the particle is repeated, and the particle is thereby advanced along the trough.

For directing the material from the discharge opening 16 of each hopper into the trough, I provide each hopper with a spout 27 which extends part way into the trough. The spout may be of any appropriate construction and, as here shown, has spaced sides 28 which extend into the trough adjacent the sides or flanges 29 of the latter. The spout has a top frame or plate 30 which is provided with an opening registering with the opening 16 of the hopper and which is suitably connected to the hopper as by means of the angle clips 31. On its forward side the spout is provided with a side wall 32, which also may extend into the trough, but which terminates short of the lower edges of the sides 28 and some distance above the bottom of the trough so as to provide a space or opening 33 for passage of the material being advanced within the trough. The sides 28 of the spout may have tapering rear edges 34, as shown in the drawings, and may be connected together for a part of the distance by a transverse member 36.

To control the flow of material from the hopper 15 into the trough 20, I provide the spout with a movable closure 38. This closure may be in the form of a plate which is hinged adjacent the rear edge of the spout for vertical swinging movement between the sides 28 thereof. In this instance the closure plate 38 is hinged at the rear edge of the spout by means of a transverse hinge pin 39 mounted in the sides 28. When material is to be fed into the trough from the hopper 15, the closure plate 38 is swung, or allowed to swing downwardly, upon its pivot pin 39 to an inclined position, with its lower end at or near the bottom of the trough. When the closure plate is in this position material flows downwardly through the hopper opening 16, and by reason of the inclination of the closure plate, is directed by this member in a forward direction towards the passage 33. The material which comes in contact with the bottom of the trough is subjected to the feeding action explained above as soon as the vibratory reciprocating movement of the trough is started. This causes the material to travel away from the inclined closure plate 38 and to move rapidly along the trough in the desired direction.

The movement of the hinged closure plate 38 may be brought about by any suitable means, such as by an actuating screw 41 provided on the transverse member 36. This screw may be arranged as shown in the drawings, so that the inner end thereof engages the bottom or back of the closure plate 38, and by adjusting the screw inwardly or outwardly the closure plate may be swung to its closed or open position. The closure plate may, if desired, be held in a partially opened position by adjusting the screw 41 to the proper extent.

For regulating the depth of material which is fed into the trough from the hopper, I provide each spout with a gate 42 which is movable toward or away from the bottom of the trough. This gate may be of any suitable construction and may, for example, be a plate extending trans-

versely within the trough and having sliding contact with the forward side walls 32 of the spout. The gate may be held in the desired position of adjustment with respect to the trough bottom by any suitable means, such as by providing one or more clamps. A clamp, of a form appropriate for this purpose, is shown in the drawings as comprising a screw 43 extending through an opening of the gate and movable in a vertical slot 44 of the wall 32. A hand wheel 45 forms a nut for the screw and serves to clamp the gate against the wall 42 to hold the gate in the desired position of adjustment.

As mentioned above, the container of Fig. 1 of the drawings is shown as having two of the hoppers 15, which are provided with spouts and flow control means of substantially identical construction. In illustrating the right hand hopper of the container, I show the hinged closure 38 as being held in its closed position by the screw 41, and I also show the gate 42 as being held in an elevated or inoperative position. The left hand hopper of Fig. 1 is shown with the hinged closure 38 in open position and allowing material to be fed through the hopper opening 16 into the trough. The gate 42 is shown as having been adjusted downwardly, with respect to the bottom of the trough, to a desired position to regulate the depth of material being fed into the trough. In the position of adjustment shown for the gate 42, the height of the opening or passage 33 has been reduced so that the depth of material being fed into the trough corresponds with a layer thickness providing a desired rate of feed. It will be noted in connection with the right hand hopper that when the hinged closure 38 is in its closed position, and when the gate 42 is in its retracted or inoperative position, neither of these members interferes in any way with the material being fed from the left hand hopper and being advanced within the trough. If the closure 38 and the gate 42, or either of these members were not retracted, they would interfere and obstruct the flow of material and the trough would become dammed up and would overflow at this point.

From the arrangement of feed control means for the hoppers, as just explained, it will be seen that a single trough or conveyor may be supplied with material from one of any number of hoppers, and that when material is supplied to the trough from one hopper the feed control means of the foremost hoppers will not interfere with the flow of material in the trough.

Vibratory movement, to provide the above explained feeding action, may be imparted to the trough in various ways, and as a feature of my invention, I provide novel means for this purpose. The trough vibrating means shown in this instance comprises a transverse bar 48 to which the closed inner end 49 of the trough is connected. This transverse bar is preferably of a length such that the ends thereof extend laterally for some distance beyond the sides of the trough. The bar itself may be of any suitable material, and for example, may be a structural channel arranged with its flat face or back against the end wall of the trough. A second transverse bar 50, preferably a flexible metal bar, extends in substantially coextensive parallel relation to the bar 48 and carries screws 51 which are mounted therein adjacent its outer ends. The bar 50 is spaced from the bar 48 by a spacing block 52, located at substantially the mid-point of the bars and substantially on the longitudinal center line of the trough. The bars 48 and 50 may be clamped

against the spacing block 52 and at the same time connected with the end wall 49 of the trough by suitable clamping bolts 53. The screws 51 of the bar 50 cooperate with anvil blocks 54 which may be mounted in the recess of the bar 48 adjacent the ends thereof.

To cause the screws 51 to rapidly strike the blocks 54 of the transverse bar 48 and thus impart a vibratory movement to the trough 20, I provide an electromagnet 56, which may be mounted upon the bar 50 substantially in line with the trough. This electromagnet may be of any suitable construction, and may have a U-like frame 57, with suitable magnetizing coils 58 thereon. An armature 59 for the electromagnet is supported in adjacent relation to the poles of the frame 57 by a bracket member 60 which has its ends connected to the bar 50 substantially midway between the screws 51 and the frame of the electromagnet. When the coil 58 of the electromagnet is energized by alternating current or by a pulsating direct current, the armature 59 is rapidly moved toward and away from the frame 57. This movement of the armature imparts a vibratory movement to the outer ends of the bar 50, which causes the screws to be rapidly pounded against blocks 54 and this, in turn, causes rapid vibrations to be transmitted to the trough through the transverse bar 48 to produce the desired feeding movement explained above.

It will be noted that in supporting the trough 20 from the container structure, the flexible plates 22 may be connected to the plates of the hoppers 15. This arrangement may be utilized to produce an action beneficial to the feeding of material from the hoppers without sticking. This result is obtained by reason of the fact that during the vibratory reciprocating movement of the trough more or less vibration will be transmitted through the plates 22 to the side walls of the hoppers, and the resulting vibration of the hopper walls even though very slight will facilitate the flow of material downwardly toward the discharge openings 16 and will avoid sticking and cavitation which might otherwise result in the hoppers.

The rate at which material is fed by the trough can be varied and may be controlled by changing the rate of vibration of the armature 59 of the electromagnet, but I prefer to obtain such control of the feed of material either by adjusting the screws 51 to obtain a trough vibration which will produce the desired rate of feed, or by adjustment of the gates 42 to regulate the depth of the layer of material being fed into the trough. Regulation of the rate of feed could, of course, be made by a combination or combinations of the regulating actions just explained. The feeding of material by the trough can be started by simply energizing the vibrating magnet 56 while one of the closures 38 is open, or by energizing the magnet and then opening one of the closures 38.

Bulk material often contains pieces of tramp iron, and when the bulk material is coal being fed to a pulverizer, such tramp iron may cause damage to the pulverizing apparatus if fed thereinto. Therefore, to separate the tramp iron from the material being fed by the trough 20, I provide an electromagnet 62 which is preferably arranged on the bottom of the trough, so that the material must pass thereover. This electromagnet is energized, preferably with direct current, and pieces of tramp iron moving with the material will be attracted and held by the magnet and

thereby separated from the material. The electromagnet may be suitably mounted on the bottom of the trough, preferably by providing the trough bottom with an opening in which the electromagnet is disposed, so that the top of the magnet forms a portion of the bottom of the trough. To improve the separating action obtained by the magnet it may be desirable to form the trough opening as a shallow pocket or recess, the bottom of which is formed by the top of the electromagnet. The pieces of tramp iron moving with the material will be arrested by the magnet and will sink into the material filling the recess or pocket, and will be thus trapped or held until they can be removed by an attendant.

From the foregoing description and accompanying drawings it will be seen that I have provided a novel form of trough feeder or conveyor, as well as a novel form of storing and feeding apparatus for bulk material. My novel trough feeder operates in a substantially horizontal plane and, therefore, when arranged beneath a container permits the container to be located relatively close to the floor, so that the container will afford large capacity and low height. Furthermore, this novel form of trough feeder may be constructed of any desired length, so that the container itself may be located close to a coal bin or storage room, which may be a considerable distance from the pulverizing apparatus or other machinery to which the material is to be supplied.

It will also be understood that I have provided novel feed control means for the container which permits the container to have a number of laterally spaced hoppers arranged to feed to a common conveyor without the feeding means of one hopper interfering with the material previously fed from another hopper. With the novel feed control means which I have provided the container may have any number of such hoppers, and, therefore, a desired storage capacity may be obtained by constructing the hopper with longer and wider dimensions and without increasing the height of the container which would necessitate a high lift of material in charging the container.

While I have illustrated and described the apparatus of my invention somewhat in detail, it will be understood, of course, that I do not wish to be limited to the precise details of construction and arrangement of parts herein disclosed, but regard the invention as including such changes and modifications as do not involve a departure from the spirit of the invention and the scope of the appended claims.

Having thus described my invention, I claim:

1. A feeding device comprising in combination a trough, a transverse member connected to the

trough with its ends extending beyond the sides of the trough, a second transverse member having an intermediate part thereof connected with the trough and having extending portions with means thereon for striking engagement with the extending ends of the first transverse member, and means for vibrating the extending portions of the second transverse member to cause such striking engagement.

2. In a feeding device the combination of a trough, a transverse member connected to the trough and extending outwardly beyond the sides of the trough, a second transverse member spaced from the first member and having means for striking engagement with the extending portions of the first transverse member, an electromagnet having a movable armature, and means connecting said armature with the second transverse member for causing such striking engagement.

3. In a feeding device the combination of a trough, a pair of spaced transverse members connected to said trough and extending beyond the sides thereof one of said transverse members being flexible and having means on the extended portions thereof for striking engagement with the extended portions of the other transverse member, an electromagnet connected with said transverse members adjacent the connection of the trough therewith, a movable armature for the electromagnet, and means connecting the armature with the extended portions of the flexible transverse member for imparting vibratory movement thereto to cause such striking engagement.

4. A feeding device comprising a trough, means mounting said trough for vibratory reciprocating movement, a transverse member connected with the trough and projecting in opposite directions therebeyond, a flexible transverse member having portions spaced from the first transverse member and adapted for striking engagement therewith, and means for flexing the second transverse member to cause such striking engagement.

5. A feeding device comprising a trough, means mounting said trough for vibratory reciprocating movement, a transverse member connected with the trough and projecting in opposite directions therebeyond, a flexible transverse member having arm portions projecting beyond the trough and provided with means for striking engagement with the projecting portions of the first transverse member, and an electromagnet having operative connection with said arm portions for flexing the same to cause such striking engagement.

AUSTIN A. HOLBECK.