

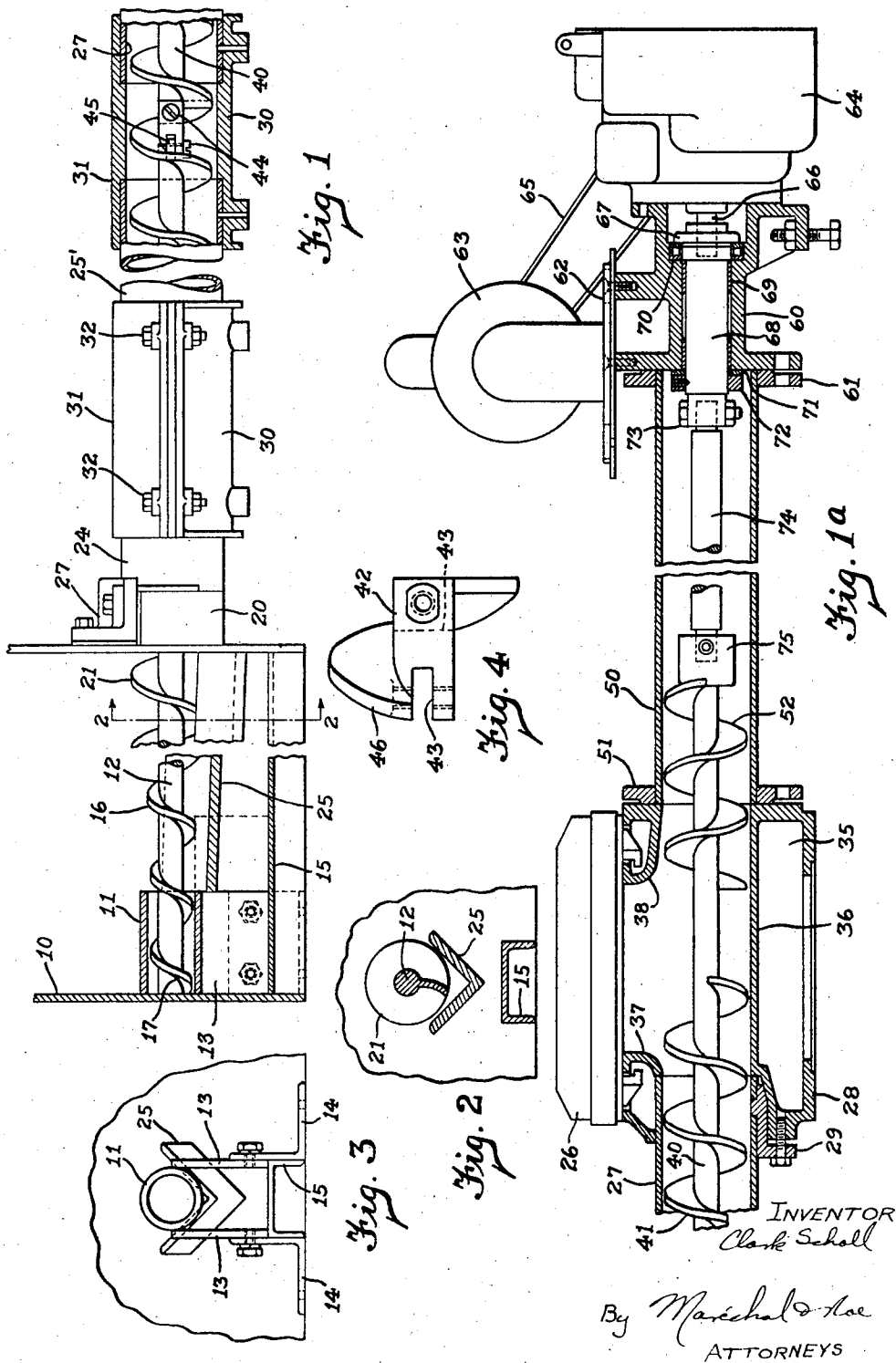
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CONVEYER FOR COMBUSTION APPARATUS

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CONVEYER FOR COMBUSTION APPARATUS

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5 Claims. (Cl. 198—64)

This invention relates to stokers and more particularly to stokers making use of a worm feed.

It is the principal object of the invention to provide a stoker for feeding solid fuel from a bin to a retort which is relatively light in weight, which feeds fuel at a proper controlled rate and with a minimum of crushing of the fuel, and which utilizes a minimum of power to effect the feeding operation.

It is a further object to provide a feeding device for use with a bin containing a quantity of solid fuel in which the feeding member may be withdrawn from and replaced in the loaded bin for inspection or repair.

It is a further object to provide a sectional worm shaft having a universal coupling therein over which the fuel is adapted to be fed substantially without obstruction.

It is a still further object to provide a feeding mechanism for supplying solid fuel to a retort and for effecting the delivery of the fuel upwardly into the retort with a minimum of churning and crushing of the fuel therein.

It is another object to provide a stoker of this character which is flexible in its application so that it may be readily adapted for operation with different sizes of furnace, different spacings from the fuel bin, and so forth.

Other objects and advantages will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing

Fig. 1 is a view partly in vertical section and partly in elevation showing the feeding worm extending into a bin for receiving solid fuel;

Fig. 1a is an extension of Fig. 1 showing the retort and the drive means for operating the feed worm, Fig. 1a fitting on the right hand end of Fig. 1;

Fig. 2 is a partial vertical sectional view through the portion of the feeding device which is within the bin on the line 2—2 of Fig. 1;

Fig. 3 is an end elevational view of the feeding device shown in Fig. 1 from the interior of the bin;

Fig. 4 is a detail view in elevation showing a universal coupling member for the worm shaft.

The present application is a division of application Serial No. 235,328, filed October 17, 1938.

In the feeding of solid fuel such as from a bin containing a supply of solid fuel into a retort, difficulty has heretofore been encountered in securing the feeding of the fuel at a proper controlled rate, and under such conditions as to avoid

crushing of the fuel and the packing of the conveyer means through which the fuel is fed. If the fuel is caused to be churned or crushed during its feeding toward the retort, or if the conveyer means becomes packed or choked with fuel during the course of the feeding operation, an inefficient operation results, requiring the use of unnecessarily large driving forces to secure the delivery of fuel to the retort. And even where supplied under such conditions, the crushing of the fuel tends to reduce the size unnecessarily, thereby changing the combustion characteristics of the retort, resulting in non-uniform and less desirable operation of the retort.

In accordance with the present invention proper control of the feeding of the fuel into the retort is secured with substantial elimination of objectionable churning and crushing of the fuel during the feeding operation, and with the feeding of a proper and regulated amount of solid fuel into the conveyer means so that the conveyer does not become choked or packed with fuel but receives only that proper quantity which can be transmitted and conveyed readily and with a minimum usage of power. The invention further provides a highly flexible construction adapted to be installed in furnaces of varying dimensions, making use of a standard operating construction, which is simply and readily adapted to the particular size requirements of the installation in a very economical manner. The invention thus provides a highly effective overall stoker installation for feeding solid fuel which is applicable to deliver solid fuel in proper condition and with a minimum power requirement from the bin directly into the retort.

As sometimes occurs in the course of the operation of a stoker of this character, it becomes necessary to withdraw and replace the feeding worm within the bin. Heretofore when such operation was required it was usually necessary to remove a substantial portion of the solid fuel from the bin in order to replace the feed worm therein. However in accordance with the present invention the entire feed worm may be easily withdrawn from a loaded bin, and may likewise be easily replace in the loaded bin without the necessity for removing the fuel therefrom.

Referring to the drawing which discloses a preferred embodiment of the invention, the inner wall of the bin is shown at 10 with the feeding device extending adjacent such wall to provide for substantially complete delivery of all of the fuel within the bin. The structure of the feeding device comprises a bearing member 11 for re-

ceiving the worm shaft 12 and supporting the inner end thereof within the bin. The bearing member 11 is formed as a section of tube or pipe welded at opposite sides to upwardly extending bracket arms 13 which in turn are bolted to a frame structure comprising angle posts 14 and an inverted channel section 15, the latter extending substantially throughout the bin and toward the delivery end of the worm.

The worm shaft 12 is of substantially constant diameter throughout, and has formed on its surface a spirally arranged conveying flight 16. The flight 16 is of uniform pitch and also substantially uniform as regards thickness so that the entire worm shaft is relatively of light weight and simple of manufacture. The face of the flight is of a varying width so as to provide a flight tapering in width from the inner end of the bin to the delivery end thereof. Preferably the smaller portion 17 of the flight which is received within the bearing 11 is of a constant diameter to provide for properly guiding and supporting the inner end of the shaft. At the delivery end of the bin there is arranged a conveyer tube 20 into which the shaft 12 extends, and the larger diameter portion of the flight 21 which lies within the delivery tube is likewise of substantially constant diameter to provide a uniform feeding action for the solid fuel as it is carried through the conveyer tube. That portion of the conveyer flight between the terminal parts 17 and 21 is of the tapering width as described, being preferably of uniformly increasing width of face between said two terminal portions. The entire conveyer worm is preferably cast as an integral unit.

The worm shaft is thus exposed on its upper face to engage and deliver the solid fuel contained within the bin. Beneath the shaft there is provided a trough 25, either arcuate in cross section or in the form of an open V-shaped member as shown for simplicity of manufacture, the walls of which are spaced uniformly with respect to the flight 16. It is found desirable to provide certain clearance between the side walls and the flight to avoid undesired rubbing of the parts upon each other under the shifting movement occurring in the conveyer shaft during operation, a clearance of about $\frac{1}{4}$ " at each side having been found satisfactory. The trough 25 slopes downwardly in the direction of the delivery end of the conveyer, cooperating with the tapered flight on the shaft for properly receiving and conveying the solid fuel picked up by the worm with a minimum of churning and crushing thereof. Such coordinated construction of tapered flight on the conveyer and the trough likewise serves to limit the quantity of fuel transmitted by the worm and carried thereby toward and into the conveyer tube 20, the shallower depth of face of the inner portion of the flight avoiding the collection and movement over the trough of an excessive quantity of fuel such as to cause packing of the conveyer and the collection of a larger quantity of the solid fuel at the entrance to the conveyer tube than can be properly conveyed there-through. Further inasmuch as the portion 21 of the conveyer flights within the conveyer tube is of larger diameter and hence of greater transmitting capacity than the tapered portion of the flight which receives the solid fuel, assurance is provided that all of the fuel delivered into the conveyer will be properly transmitted there-through without packing or collecting therein. Further the fuel is not churned around and

crushed by the exposed portion of the worm but is caused to feed forward smoothly and easily over the trough with a minimum usage of power.

At the inlet end of the conveyer tube there is preferably provided a shear plate 27 which may be removed as required in order to secure access to the conveyer at the point of entrance to the tube, such as to remove solid objects that might be present in the solid fuel and which would make it impossible for the conveyer to operate. A suitable construction of shear plate for this purpose is shown in the patents to Burton 1,905,342 and 1,946,776 assigned to the same assignee as this application. A short section of tubing 24 extends from the shear plate and receives the conveyer therein.

An additional section 25' of the conveyer tube may be provided of such length as required and suitably secured to the adjacent sections in order to secure the proper length of the conveyer feed means. As will be understood the distance through which the conveyer must operate from a bin to the furnace will vary in different installations, and it merely becomes necessary to provide the proper length of feed worm, making use of such length of conveyer tube as required for that purpose. The retort itself is shown at 26, and a conveyer tube 27 is suitably attached to the base 28 of the retort by means of a retaining collar 29.

In order to secure the conveyer tube 25' in feeding relation between the sections 24 and 27 a pair of similar split clamping members are provided which as shown comprise a lower semi-cylindrical half 30 into which the adjacent end of the conveyer tube is fastened. The top half 31 is removably fastened to the lower half by bolts 32, thus making it possible by removing the two upper halves, to effect removal of the intermediate conveyer tube 25'. This provides for withdrawal of the conveyer worm as described below.

The retort is formed with an air inlet passage 35, and with a web portion 36 which serves as a continuation of the conveyer tube through the base of the retort, the wall of the base part being curved and opening upwardly as shown at 37 directly below the retort, to provide for delivery of the solid fuel thereinto. The fuel is delivered upwardly in regulated and uniformly distributed manner between the upwardly curving walls 38 of the retort.

A second worm shaft 40 extends through the retort, and into the tube 27 adjacent the end of the shaft 12. Shaft 40 is likewise formed with a conveying flight 41 thereon for feeding the fuel forwardly through the tube for delivery into a position beneath the retort 26. In order to provide for the driving of shaft 12 and the relative shifting thereof with respect to shaft 40, a universal driving connection is provided between the adjacent ends of the worm shafts 12 and 40. This member is shown at 42 as comprising a central hub portion of substantially the same diameter as that of the two worm shafts. At each end the hub is formed with a groove 43 adapted to receive a cooperating tongue on the end of the adjacent conveyer shaft, the two grooves in the ends of the member 42 extending at right angles with respect to each other. Bolts 44 are threaded into member 42 and pass through the tongues 45 formed upon the end of the shafts, respectively, each tongue and shaft being thus adapted to pivot with respect to hub 42 about the axis of the respective bolts. The hub portion 42 is likewise

provided with a spirally curved portion 46 which is constructed to function as a continuation of the flight on the adjacent ends of the conveyers, being formed as shown to cover substantially three-fourths of a revolution and to line up directly with the flight portions on each of the conveyor shafts. As will be clear from the drawing and from the above description, there is practically no change in the effective conveying area of the tube as a result of the provision of such universal joint and the conveying action of the worm is thus made to progress continuously and uniformly substantially without interruption.

It may become necessary during the operation of the stoker to remove the conveying worm from the bin for repair or replacement, and the construction of the present invention provides for such operation in a simple manner and without the necessity of removing the solid fuel within the bin. To remove the worm, the two upper clamping members are removed, affording access to the universal joint. Upon removal of the bolts therefrom, the entire intermediate conveyor tube and the worm shaft may be withdrawn from the bin, the shaft being rotated if desired to avoid as much as possible the drawing of fuel out of the bin. To replace the same, the shaft is merely guided into position by the trough 25, meanwhile being rotated to cause the worm to thread its way into the fuel. The tube is then clamped into final position and the two sections of the worm coupled together.

At the side of the retort opposite that through which the solid fuel is delivered there is provided an additional tube 50 which is mounted upon the end of the retort by means of a collar 51 in axial alignment with tube 27 and with surface 36, in position to receive the extending end of conveyor shaft 40. A reverse flight 52 is formed upon this portion of shaft 40, of such character as to prevent the delivery and passage of fuel into the tube 50, which is thus kept substantially clear and free of fuel during the operation of the device. In order to provide for the proper feeding of the fuel upwardly into the retort in uniformly distributed manner, and to avoid unnecessary churning thereof beneath the retort, the forward flight 41 and the reverse flight 52 terminate in definite spaced relation to the other, to the walls defining the opening in the retort and preferably in predetermined angular relationship. With retorts of larger dimensions such as those for example for burning up to 350 pounds of fuel per hour and greater, it is found that the reverse flight should not extend substantially beyond the projected wall of the retort, as otherwise the uniform supply of fuel to that side of the retort is impaired. The forward feeding flight should extend into the retort a distance approximately between one-third and one-half of the length of the retort, to secure uniformity in delivery of the fuel. The same general relations apply to retorts of smaller capacity, and with such smaller sized retorts capable of burning for example up to about 50 pounds of fuel per hour, such relationship will result in the adjacent ends of the forward and reverse flights terminating in such relation as to be spaced apart by a distance varying from approximately once the pitch of the flights to half the pitch of the flights. With such relationship, as shown in the drawing, very satisfactory delivery of fuel upwardly in uniformly distributed manner into the retort is secured with substantial reduction or elimination of objectionable crushing and churning of the fuel beneath

the flights and upon the wall 36 of the retort. Further in order to secure satisfactory delivery of the fuel without churning it has been found desirable to arrange the end of the reverse flight in predetermined phase relation with respect to the end of the forward flight so as to lead the latter by approximately a quarter revolution. In the arrangement shown the forward flight 41 terminates with respect to the end of the reverse flight 52 at a distance approximately half of the pitch of the flights, and lagging the reverse flight by approximately a quarter of a revolution.

The driving means for operating the conveyer is carried by a supporting casting 60 against which the end of tube 50 is fastened by means of a retaining collar 61. A motor bracket 62 is mounted upon upwardly projecting portions of the casting 60 and the drive motor 63 is arranged to drive a reduction gear device 64 through a drive belt 65. The reduction gear device is formed with a projecting driving shaft 66 which is of non-circular cross section, and adapted to be removably received in driving relation with a similarly formed end collar 67 integrally formed with a connecting member 68. Member 68 is journaled within the supporting member 60 as shown at 69, and a thrust bearing 70 provides for properly taking of the thrust of the shaft through collar 67. Suitable means comprising a washer 71 and a retaining collar 72 provided over the end of the connecting member 68 serve to prevent the access of fuel, dust, and the like into bearing 69.

The end of the connecting member 68 projects into the tube 50 and is there provided with a pivotal connection 73 with the end of a connecting shaft 74, shaft 74 being thus positively rotated by the connecting member and being capable of angular adjustment with respect thereto. Shaft 74 is pivotally connected at its opposite end with a hub 75 formed upon shaft 40, and thereby serves to transmit the driving force from the connecting member into the worm shaft. This construction provides for flexibility in the arrangement and application of the device to different installations, inasmuch as the driving assembly including the connecting member 68 may be constructed as a unitary device and of standard dimensions, and the proper adjustment made in each case to fit the installation by appropriately changing the length of tube 50 and of shaft 74, such adjustment being very readily made and simply carried out.

The invention therefore provides a highly satisfactory, simple, and light weight, and economical stoker device for use in feeding solid fuel directly from a bin into a retort for combustion therein. The device provides for such fuel delivery in a predetermined desired quantity and under such controlled conditions that not only is the power required kept within a minimum, but the fuel is delivered in the desired form, and without substantial crushing or packing thereof. And the entire construction is made flexible and readily adapted to any particular installation.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A stoker of the character described adapted to feed solid fuel from a bin comprising a worm

shaft having conveyer flights thereon extending into said bin, a flat-walled V-shaped trough positioned beneath said shaft where exposed in the bin, means for rotatably supporting one end of said worm shaft within said bin by contact of the flights thereof upon the walls of said trough and providing for free withdrawal and replacement of the shaft along the length of said trough, a conveyer tube extending away from said bin and receiving the other end of said worm shaft, a second worm shaft within said tube also having a conveyer flight thereon, and a universal joint normally connecting said two worm shafts in driving relation with each other, said universal joint providing for relative shifting in the axial alignment of said two shafts during rotation thereof and also providing for disconnecting said worm shafts to permit withdrawal and replacement of said first shaft, said universal joint being formed with a central portion not substantially larger in diameter than said shafts and having a portion of a flight formed thereon joining and in regular continuation of the flights on said worm shafts to normally effect continuous feeding of said fuel while avoiding packing and crushing of the fuel at said joint.

2. A stoker of the character described adapted to feed solid fuel from a bin and having a conveyer member removable from and replaceable in the loaded bin comprising a worm shaft extending into said bin and having conveying flights thereon, the face of said flights being of uniformly tapering width increasing toward the discharge end thereof, a flat walled substantially V shaped trough beneath and in direct supporting relation to said flights at spaced points above the bottom of the trough and below and on opposite sides of the axis of said shaft, said trough sloping downwardly toward the discharge end of the bin and said slope corresponding with the increase in width of said flights to provide continuous support along the length of the flights with the axis of the worm shaft maintained substantially horizontal, and means located beyond the discharge end of the bin for driving said worm shaft.

3. A stoker of the character described adapted to feed solid fuel from a bin and having a conveyer member removable from and replaceable in the loaded bin comprising a worm shaft extending into said bin and having conveying flights thereon, the face of said flights being of uniformly tapering width increasing toward the discharge end thereof, a substantially V shaped

trough beneath and in direct supporting relation to said flights, the trough being defined by plane surfaces in direct contact with said flights at spaced points above the bottom of the trough and on the opposite faces of the flights, said trough sloping downwardly toward the discharge end of the bin to provide continuous support for the tapering flight to support the same with the worm axis located and supported in a substantially straight line.

4. A stoker of the character described adapted to feed solid fuel from a bin and having a conveyer member removable from and replaceable in the loaded bin comprising a worm shaft extending into said bin and having conveying flights thereon, the face of said flights being of uniformly tapering width increasing toward the discharge end thereof, a substantially V shaped trough beneath and in direct supporting relation to said flights, said flights contacting the opposite sides of said trough at spaced points above the bottom of the trough, the trough being defined by intersecting plane surfaces and sloping downwardly toward the discharge end of the bin to provide continuous support for the tapering flight to support the same with the worm axis located and supported in a substantially straight line, and means for rotatably supporting the end of the worm located at the innermost part of the bin.

5. A stoker of the character described adapted to feed solid fuel from a bin and having a conveyer member removable from and replaceable in the loaded bin comprising a worm shaft extending into said bin and having conveying flights thereon, the face of said flights being of uniformly tapering width increasing toward the discharge end thereof, a substantially V shaped trough beneath and in direct supporting relation to said flights, the trough being defined by intersecting plane surfaces and sloping downwardly toward the discharge end of the bin to provide continuous support for the tapering flight at spaced points below and on opposite sides of the axis of said shaft to support the same with the worm axis located and supported in a substantially straight line, and a cylindrical conveyer tube extending in continuation of said straight line and communicating with the discharge end of said worm, the width of face of the flights extending into said cylindrical conveyer tube being greater than that of the greatest diameter of the worm flights in the bin.

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