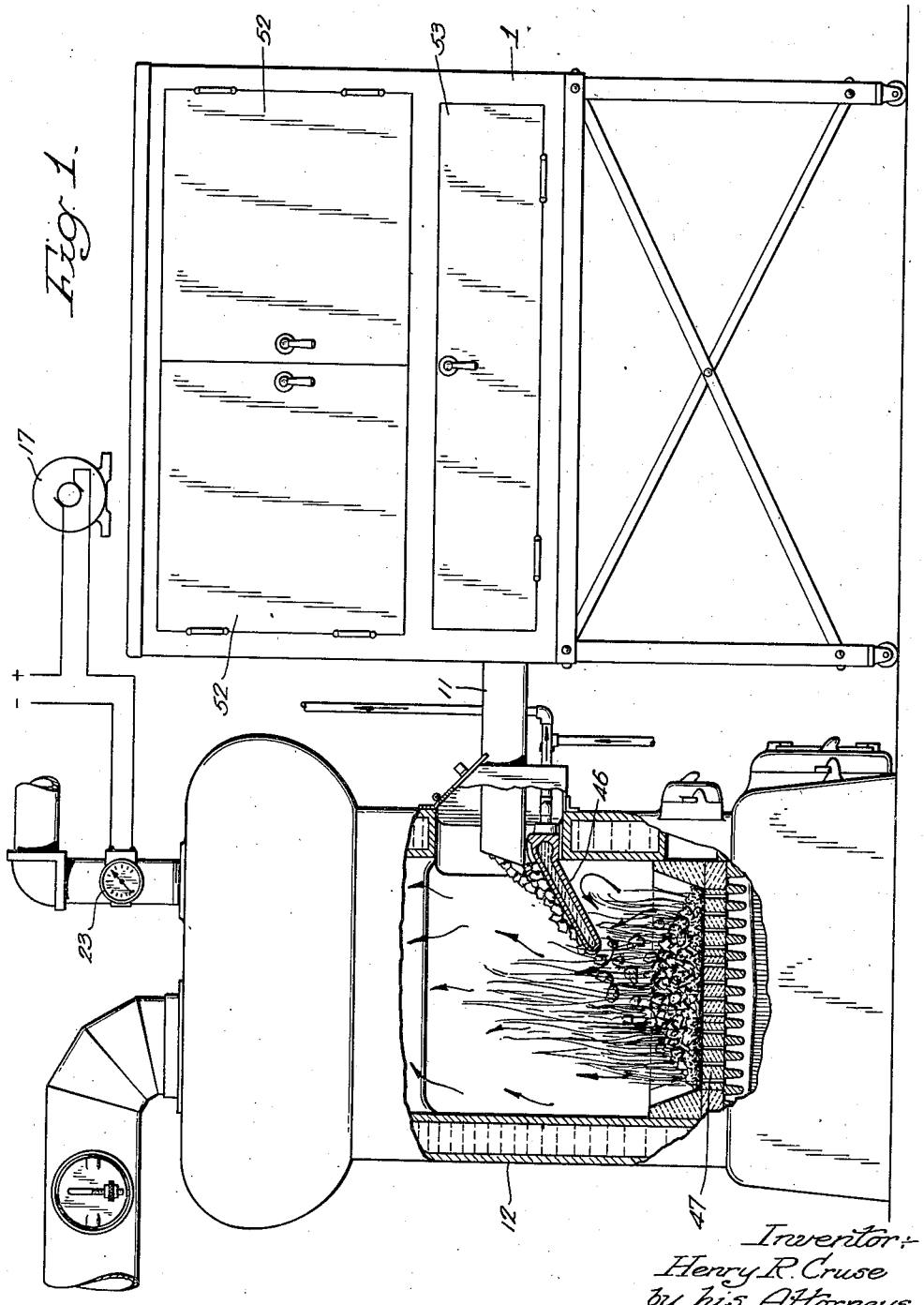
Sept. 27, 1938. H. R. CRUSE 2,131,499

FUEL FEEDING DEVICE

Filed June 15, 1935 4 Sheets-Sheet 1

Fig. 1.




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FUEL FEEDING DEVICE

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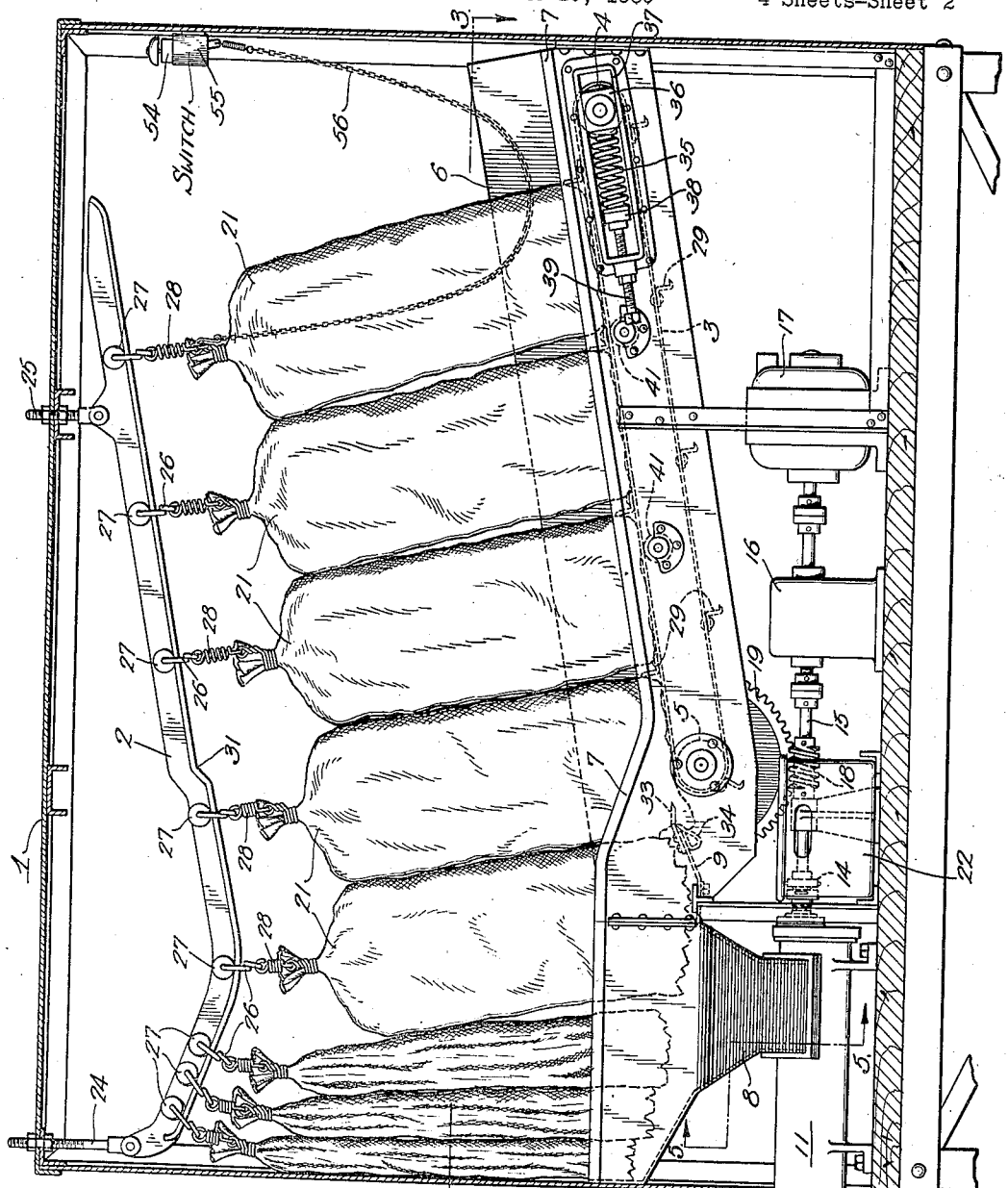



Fig. 2.

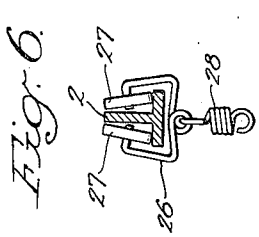


Fig. 6.

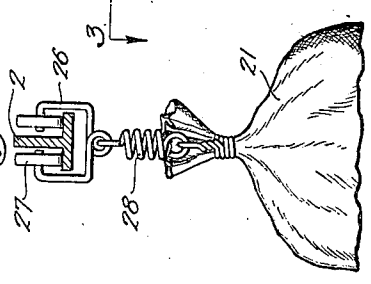


Fig. 7.

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FUEL FEEDING DEVICE

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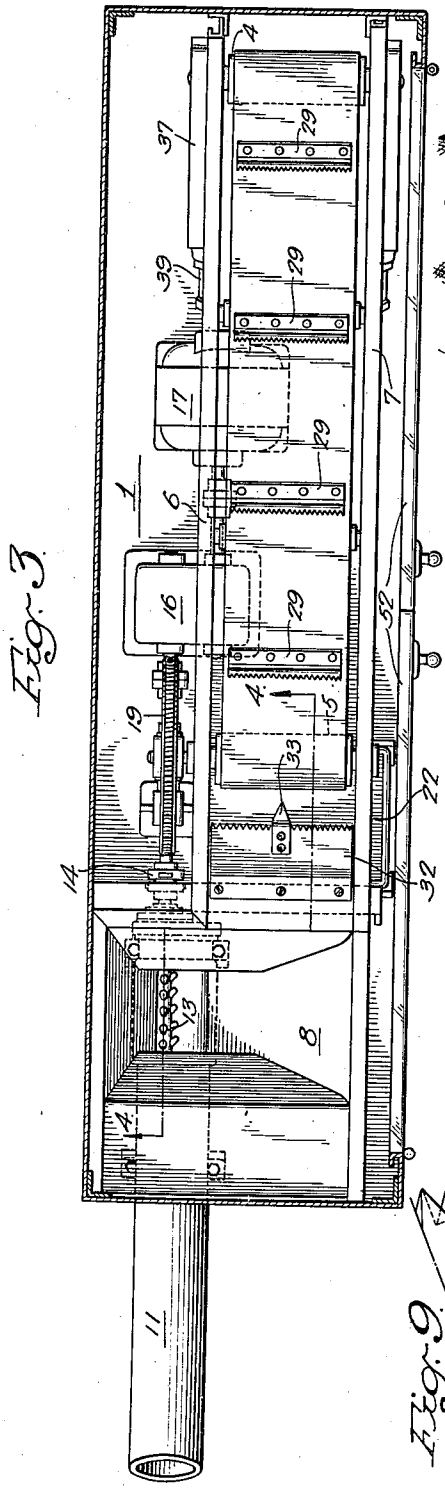


Fig. 3.

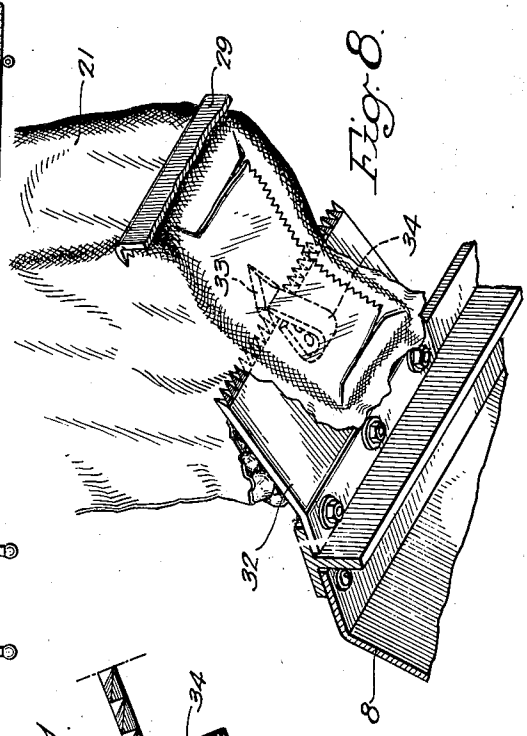


Fig. 8.

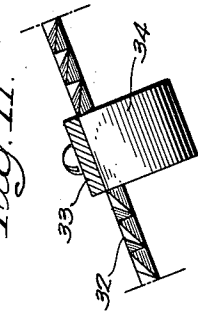


Fig. 11.

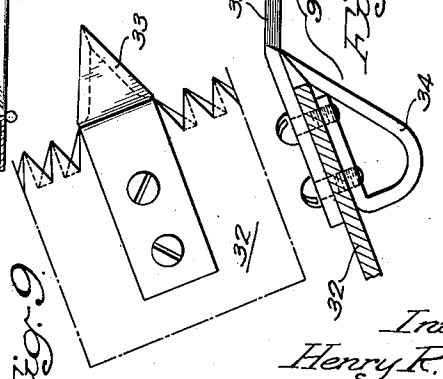


Fig. 10.



Fig. 9.

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FUEL FEEDING DEVICE

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Fig. 4.

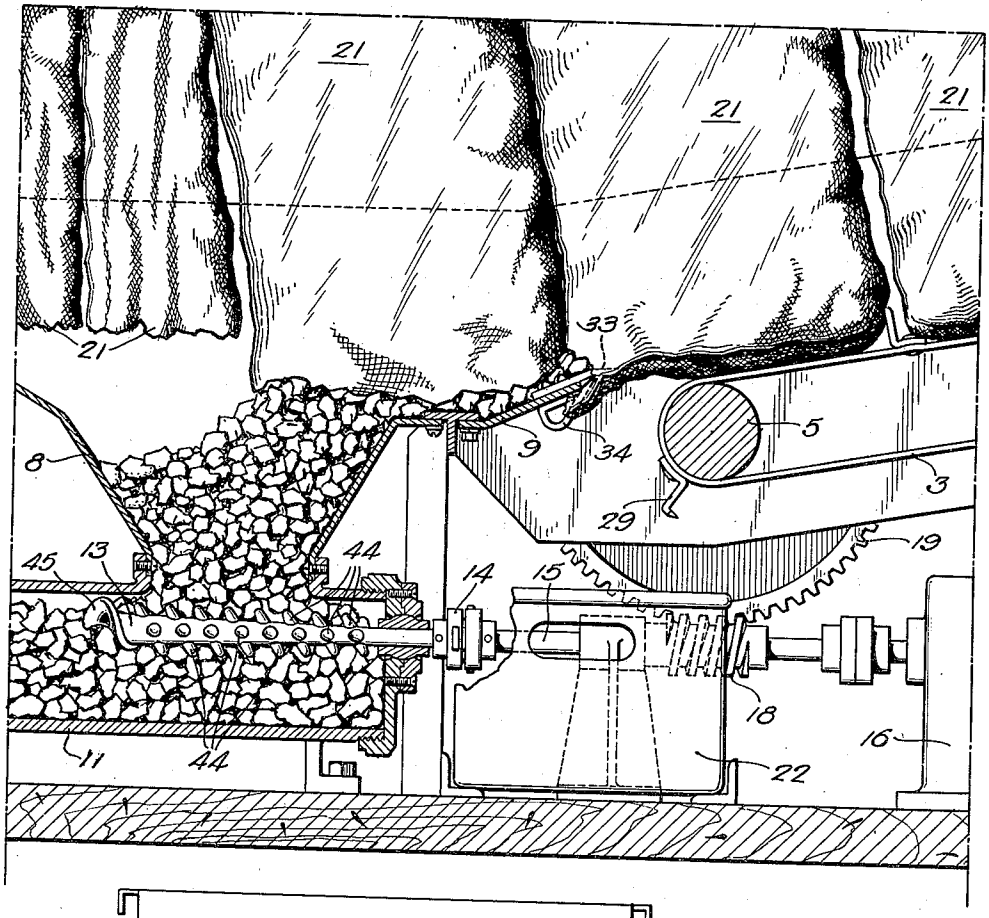
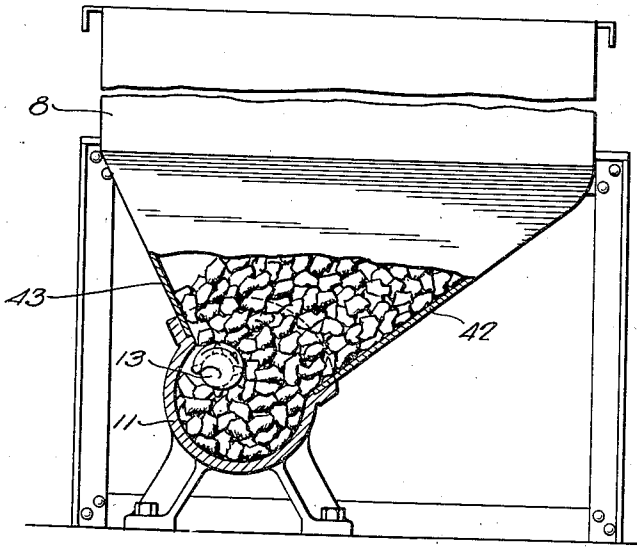



Fig. 5.




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Patented Sept. 27, 1938 2,131,499

# UNITED STATES PATENT OFFICE

2,131,499

## FUEL-FEEDING DEVICE

Henry R. Cruse, Abington, Pa.

Application June 15, 1935, Serial No. 26,842

5 Claims. (Cl. 214—1)

This invention relates to improvements in automatic fuel-feeding devices or stokers, and while applicable in principle to the stoking of other fuels has an application of particular utility to the stoking of fuels, such as petroleum coke, that are substantially free from ash residue.

One object of my invention is to provide fuel-feeding mechanism designed to receive the fuel in readily handled packaged units, and automatically operative to effect discharge of the fuel from the said packages and to feed the fuel in bulk at controlled rates to the combustion chamber of an associated furnace.

To this general end, the invention contemplates the provision of novel apparatus and mechanism for conveying the packages successively to a predetermined point, and to provide means at said point for disrupting the packages to permit the fuel to pass to a suitable conveying mechanism by means of which it is fed at predetermined rates to the said combustion chamber.

Still another object of the invention is to provide means for separating the disrupted envelope of said packages from the fuel to prevent any substantial portion thereof from passing to the fuel-conveying elements and being fed by said elements to the combustion chamber.

A still further object of the invention is to provide novel means for protecting the furnace end of the conveying apparatus from the heat developed in the combustion chamber, and for utilizing said heat for domestic hot water supply.

As a still further object, my invention contemplates the provision of a fuel-feeding mechanism of the type described in the form of a portable unit that may be readily moved to and from a normal position relative to the furnace with which it may be associated, thereby providing, among other advantages, for hand-firing of the furnace when required.

The invention further resides in certain novel structural and mechanical features and details hereinafter described, including a novel fuel-feeding element capable of efficiently feeding solid fuels of various and mixed sizes, such for example as petroleum coke, with a minimum amount of destructive effect upon the latter.

In the attached drawings:

Figure 1 is an elevational and partial sectional view of a furnace equipped with a fuel-feeding unit made in accordance with my invention;

Fig. 2 is a sectional view showing the details of the fuel-feeding unit;

Fig. 3 is a section on the line 3—3, Fig. 2;

Fig. 4 is a section on the line 4—4, Fig. 3;

Fig. 5 is a section on the line 5—5, Fig. 2;

Figs. 6 and 7 are fragmentary sectional views illustrating details of the package-supporting trolley;

Fig. 8 is a fragmentary sectional perspective view illustrating details of the devices for rupturing the packages; and

Figs. 9, 10 and 11 are fragmentary views showing the package-rupturing elements.

With reference to Figs. 1 and 2 of the drawings, it will be noted that the mechanism comprises a frame and housing 1, in the upper portion of which is adjustably mounted a trolley rail 2. Below the rail and extending in the same vertical plane is an endless conveyor 3 operating on rollers 4 and 5 between side plates 6 and 7. The conveyer 3 and the immediately overlying portion of the rail 2 are inclined downwardly as shown. The side plates 6 and 7 terminate at their lower ends and at the left side of the housing as viewed in Fig. 3 in a hopper 8, and mounted between the side plates and in a location intermediate the lower end of the conveyer 3 and said hopper is a blade and deflector plate 9, the details of which will be hereinafter described. The hopper 8 discharges at the bottom into a conveyer tube 11 which projects through the wall of the housing and which as shown in Fig. 1 is adapted to project into the combustion chamber of a furnace 12. As shown in Fig. 4, the conveyer tube 11 has mounted in the interior thereof and at the open bottom of the hopper 8 a rotary fuel-feeding element 13, the function of which is to directionally agitate the fuel in the hopper and to advance the fuel entering the tube from the hopper through the tube for eventual discharge into the furnace 12. The element 13 is connected through a suitable coupling 14 with a shaft 15, this shaft in turn being coupled through a gear reduction unit 16 with a motor 17. The shaft carries a worm 18 which meshes with a worm wheel 19 on the conveyer roller 5 providing for operation of the conveyer in synchronization with the fuel feed element 13.

In the operation of the mechanism as described above, the rail 2 and conveyer 3 function cooperatively to support and advance toward the hopper 8 one or a series of fuel packages, such for example as sealed paper bags 21 containing the fuel. At the lower end of the conveyer, the bottoms of the bags 21 are brought into engagement with the blade 9, which as hereinafter described is designed to remove the bottoms of the bags, the said bottoms passing downwardly between the

blade and the end of the conveyer 3 into a receptacle 22 provided for that purpose. The fuel tending to pass by gravity from the open bottoms of the bags 21 is guided by the deflector 9 and side plates 6 and 7 into the hopper 8, and from the hopper to the tube 11, from whence as previously set forth it passes to the furnace. The empty bags still supported upon the rail 2 are forced to the end of the rail by the succeeding bags as illustrated. Operation of the motor 17 may be controlled automatically by suitable thermostatic devices, such for example as illustrated at 23 in Fig. 1.

As shown in Fig. 2, the rail 2 is supported in the present instance by two studs 24 and 25 which provide for vertical adjustment of the opposite ends of the rail to the required inclination. As shown in Figs. 6 and 7, the rail is of inverted T-section, and the individual trolleys which support the bags 21 each comprises a resilient substantially U-shaped bracket 26 which embraces the lower portion of the rail and has journaled on its extremities rollers 27, 27 which travel on the flanges of the rail, as shown. At the bottom of the bracket 26 is a spring 28 from which the bags 21 are suspended, as illustrated. The normal unloaded condition of the trolley is illustrated in Fig. 6, and when the load of the bag is imposed upon the spring 28, as shown in Fig. 7, the bracket assumes an extended position in which the wheels 27 occupy substantially vertical positions closely adjacent the vertical web of the rail 2 and spring 28 is extended.

One of the functions of the rail 2 is to relieve the conveyer 3 of a portion of the weight of the fuel packages and to thereby reduce the power required to advance the packages to the discharge position. Positive feeding of the bags by the conveyer is effected by means of a series of transverse lugs 29 which project outwardly from the conveyer 3 and which as shown in Fig. 3 are provided with serrated leading edges which engage the rear side of the bags, as shown in Fig. 2. In normal advance movement of the packages and when the latter have advanced to the point where the blade 9 engages the forward side of the bag, the associated trolley has advanced along the rail 2 to the point designated 31 in Fig. 2, where the rail takes an abrupt drop. The resulting abrupt downward movement of the trolley permits substantially the entire weight of the package to fall upon the conveyer 3 and brings the lower corner of the bag 21 forcibly against the blade 9, thus insuring penetration of the tough material from which the bag is formed by the blade.

The form of the blade 9 and the manner in which it functions to remove the bottom of the bag are illustrated in Figs. 8 to 11, inclusive. The blade structure comprises a plate 32 which corresponds in width substantially to the space between the rails 6 and 7, see Fig. 3, and which as shown in Fig. 2 extends at an upward inclination from the edge of the hopper 8 toward the lower end of the conveyer 3. The outer edge of the plate 32 is serrated, and the edges of the serrations are beveled to produce cutting edges. Located centrally of the plate 32 and projecting beyond the serrated edge thereof is a pointed prong 33, the side edges of this prong also being beveled to provide relatively sharp edges. This prong projects at an angle to the inclined plate 9 and in a substantially horizontal plane. At the under side of the plate 32 and below the prong 33 is a deflector element 34 which functions to guide the bottom separated portion of the bag downwardly toward the receptacle 22. The function of the prong 33 is to initially penetrate the tough carcass of the bag 21, and to form in effect an entering wedge which insures the subsequent proper functioning of the serrated edge of the plate 32 to sever the bottom of the bag from the advanced side of the latter, as shown in Fig. 8. During this cutting operation, the bag is positively fed against the blade by the serrated flange 29 of the conveyer, and the serrations of the plate 32 function not only to cut the bag but also to hold the material in position for efficient cutting. During this cutting operation, also, the contents of the bag are prevented from falling downwardly to the receptacle 22 by the plate 32, which thus in effect guides the fuel to the hopper 8. The serrated lugs 29 of the conveyer function also to aid the blade 9 in efficiently removing the bottom of the bag. These lugs penetrate the rear sides of the bags in their advance movement toward the stationary blade, and in their subsequent downward rotary movement cooperate with the fixed blade to cleanly remove substantially the entire bag bottom. The bag bottom, which in this operation is separated from the body of the bag, is deflected downwardly by the deflector 34 through the space between the serrated edge of the blade and the adjacent end of the conveyer 3 and lodges in the receptacle 22 together with any dust or particles of fuel which may have found their way between the blade 9 and the conveyer.

From a point above the hopper 8, the rail 2 inclines upwardly, and as the bags are advanced over the hopper and are emptied by gravity, the succeeding bags force the trolleys supporting the bags previously emptied up this inclined portion of the rail, the empty bags thereby being elevated slightly from the hopper.

It will be noted that the conveyer 3 is tensioned by means of springs 35 which engage journal blocks 36 supporting the roll 4 and tend to force these blocks outwardly in inclined guideways 37 in which they are slidably mounted. The springs 35 are engaged at their opposite ends by spring seats 38, the positions of which may be adjusted through the medium of screws 39 to thereby vary the compression of the springs. Intermediate the rollers 4 and 5 the upper run of the conveyer is supported by idler rollers 41, 41.

The construction of the hopper 8 and its relation to the conveyer tube 11 is shown in Figs. 4 and 5. It will be noted by reference to Fig. 5 that the forward wall 42 of the hopper 8 is inclined at a relatively small angle to the horizontal as compared with the opposite wall 43 of the hopper, and that the wall 42 intersects the tube 11 at a point approximately midway of the vertical tube dimension, whereas the opposite wall 43 intersects the tube at a point relatively close to the top thereof. The feeding element 13, which in operation is rotated in the direction of the arrow, see Fig. 5, is located adjacent the point of intersection of the tube 11 by the wall 43 and in eccentric position with respect to the tube 11 and relatively close to the upper edge of the intake opening.

The element 13, as best shown in Fig. 4, comprises a stem which increases gradually in diameter towards its free end, and this stem is provided with projecting knobs or teeth 44 which are arranged in a helical series around the stem. In general, these teeth are so relatively arranged that as the stem is rotated the teeth have a cooperative tendency to agitate the particles of fuel,

and this agitation is directional in the sense that the impulses occur longitudinally of the tube and in the direction of the discharge end thereof. The desired feeding effect is thereby obtained without the tendency of the usual screw conveyer to become clogged, and when clogged to degrade the fuel particles. The desired effect is also aided by the tapered formation of the element **13**. The free end of the element **13** is provided with a helical flange **45** which has a more positive forward thrust effect upon the fuel particles than do the teeth **44**. When the fuel has been advanced by the said teeth into a position in which it may be operated upon by the flange **45**, it has a substantially unrestricted path to the discharge end of the tube, so that the helix **45** may operate efficiently and without danger of clogging or mutilating the fuel particles. By locating the element **13** as described above, I have found that the feeding action thereof, especially when handling a fuel such as petroleum coke, is considerably more efficient than where, as in accordance with the conventional practice, the feeding element is located in an axial position in the feed tube. While there is a tendency for the entire mass of fuel to move outwardly through the tube **11**, the fact that the cross sectional area of the end of the element **13** is so much smaller than the cross sectional area of tube **11** creates a tendency for the layer of fuel in same plane as element **13** to advance more rapidly than layers of fuel below the element **13**. These lower layers are carried forward by frictional contact between themselves and the layers in the plane of the element **13** which prevents packing and unnecessary degradation of fuel in tube **11**. The device is productive of an efficient feeding action with a minimum of breakage and disintegration of the individual fuel particles and is relatively noiseless.

For the purpose of compactness, the capacity volume of the hopper **8** exclusive of the capacity volume of the tube **11** may be proportioned to accommodate the fuel contained in one package unit. Under these conditions, in order to function continuously, the forward velocity of the packages **21** on the conveyer **3** must be synchronized with the delivery velocity through the tube **11**, so that the time required to advance one of the packages completely over the blade **9** must be equal to that required for the element **13** to force the volume of fuel contained in one of the packages through the tube **11**. This is readily accomplished in the apparatus described wherein the conveyer **3** and the element **13** are both actuated from the same source of power through suitable reduction gearing. It is obvious that the intervals between recharging periods, i. e., the periods when fresh packages must be placed in the mechanism, may be increased either by extending the conveyer **3** or by increasing the width of the apparatus to accommodate larger packages or a large number of relatively small packages.

As shown in Fig. 1, the frame and housing **1** may take the form of a mobile unit which may be moved to and from the furnace as required. Access to the interior of the housing is provided in this case by doors **52** which normally may be kept closed and which may be opened for the purpose of removing the empty bags and inserting additional fuel packages in the apparatus. A door **53** is also provided affording access to the motor and gear units and to the receptacle **22**.

In Fig. 2, I have illustrated a simple and effective means for signalling the requirement for additional fuel supply. This device consists of an electric alarm **54** controlled by a switch **55**, this switch being connected through a flexible connector **56** with the trolley supporting the last of the full bags **21**, the arrangement being such that as this bag approaches the point of discharge, the connector **56** will be drawn taut to close the switch **55** and to thereby actuate the alarm **54**.

While the above described apparatus will be found of particular utility in connection with a fuel such as petroleum coke, which is substantially ashless and which, therefore, does not involve the problem of ash control and disposal, it is apparent that it may find useful application as a stoking or feeding means for other forms of fuel. It provides a simple and clean method of handling fuel in sealed or closed packages, and eliminates the necessity of handling fuel in bulk with the attendant dirt and inconvenience.

It will be understood that there may be some modification without departure from the invention as defined in the appended claims.

I claim:

1. In fuel-feeding apparatus, the combination with a bulk container for said fuel, of means for conducting the fuel in packaged units to said container, said packages comprising frangible envelopes, a fixed cutter element positioned in the path of said packages for engagement with the bottom portions of said envelopes, said conducting means comprising a conveyer, means for actuating the conveyer to urge the packages against said cutter, and a shearing element on said conveyer cooperating with said fixed cutter for severing the bottom of the envelope to thereby permit passage of fuel to the hopper.

2. In a fuel-feeding apparatus, the combination with a hopper, of means for conducting fuel in frangible envelopes to a position above said hopper, a shearing element positioned in the path of said packages and comprising a serrated cutting edge for engagement with the bottom portions of said envelopes, and a sharpened projection at the center of said shearing element for initially penetrating the envelope, said conducting mechanism comprising means for urging the envelopes against said shearing element to thereby sever the bottom portions of said envelopes.

3. In fuel-feeding apparatus, the combination with a hopper, of means for conducting fuel in frangible envelopes to a position above said hopper, a shearing element positioned in the path of said packages and comprising a serrated cutting edge for engagement with the bottom portions of said envelopes, a sharpened projection at the center of said shearing element for initially penetrating the envelopes, said conducting mechanism comprising means for urging the envelopes against said shearing element to thereby sever the bottom portions of said envelopes, and a shearing element engaging the rear of said packages and cooperative with said shearing element first named to remove the bottoms of said envelopes.

4. In fuel-feeding apparatus, the combination with a hopper, of mechanism for conducting packaged fuel in frangible envelopes to the hopper, said conducting means comprising an overhead rail, a trolley adapted to travel on said rail and from which said packages are suspended, a cutter element located in the path of said packages, and conveyer means for urging said packages toward the cutter, said rail comprising

a depressed portion located in a position above said cutter element and affording a sudden gravity movement of said packages into engagement with said cutter to thereby effect an initial penetration of the said envelope by the cutter.

5. In a furnace stoker, the combination with a bulk container for fuel and mechanism for feeding said fuel from the container to the furnace at variable rates, of mechanism for conveying fuel in packaged units and for delivering the fuel from said packages to the container, said last-named mechanism comprising a conveyer device and means for mounting on said conveyer a supply of fuel in the form of said packaged units sufficient to maintain the furnace in operation for a predetermined period, said conveyer being operative to advance said units successively into a position above the container, means for rupturing the packages in said position to permit the contained fuel to empty into the container, and means for actuating said conveyer in synchronism with said fuel-feeding mechanism to maintain in said container a continuous adequate supply of fuel independently of the rate of said feed.

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