Feb. 21, 1939. C. E. HAALAND 2,148,022

HAMMER MILL

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FIG. 1.

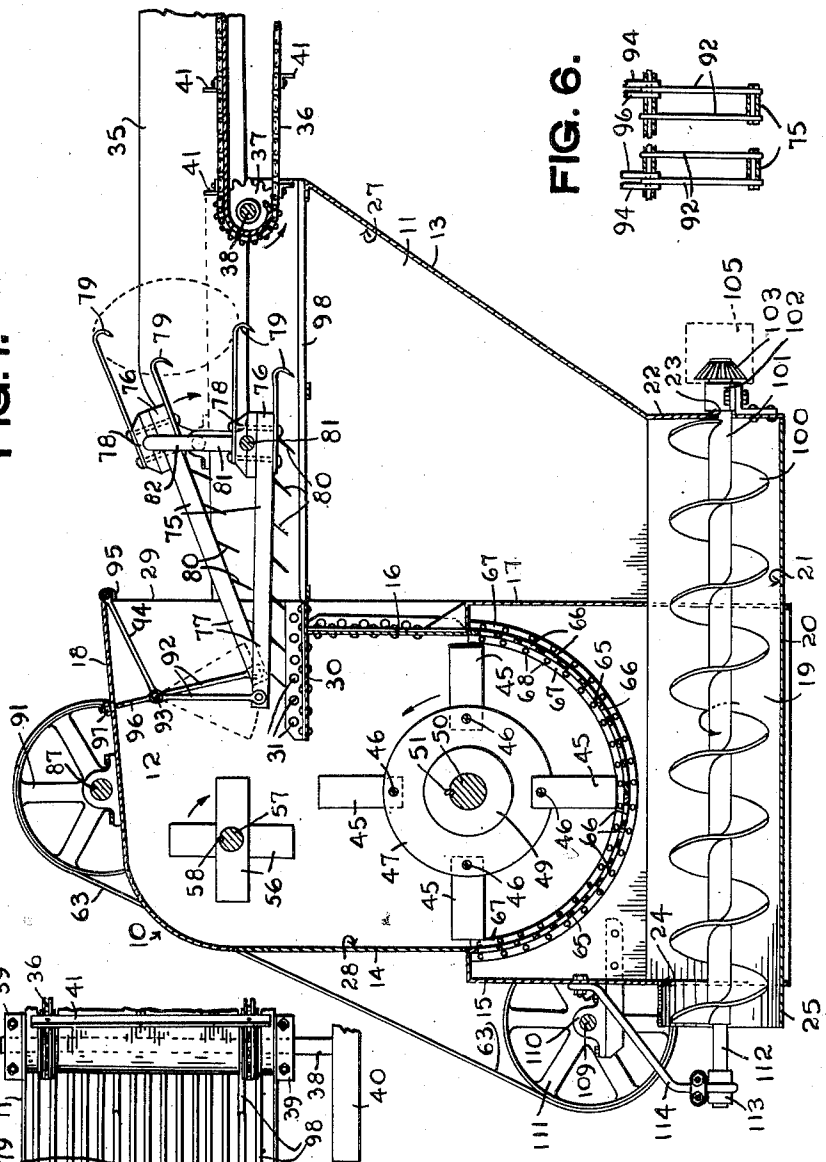
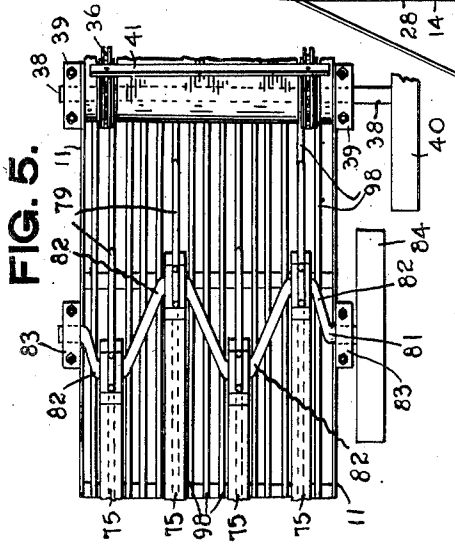


FIG. 6.

FIG. 5.



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HAMMER MILL

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FIG. 2.

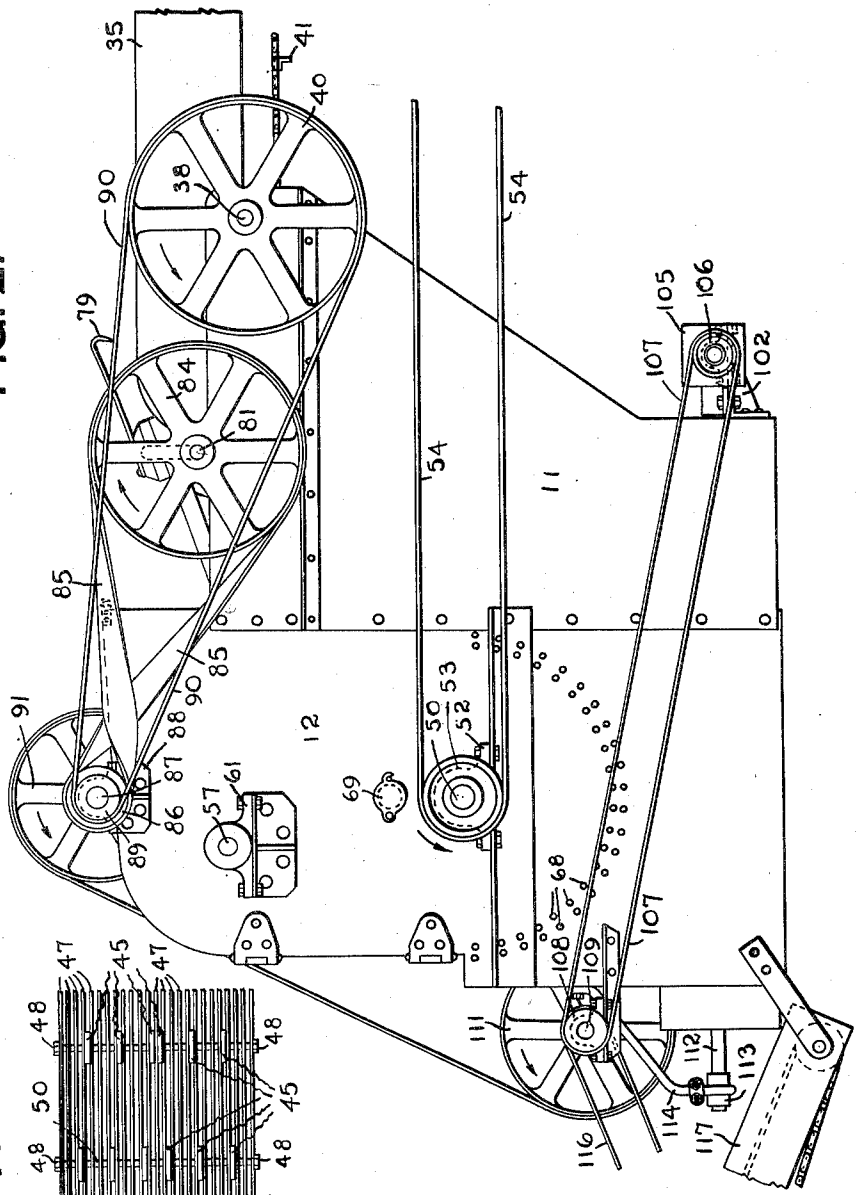
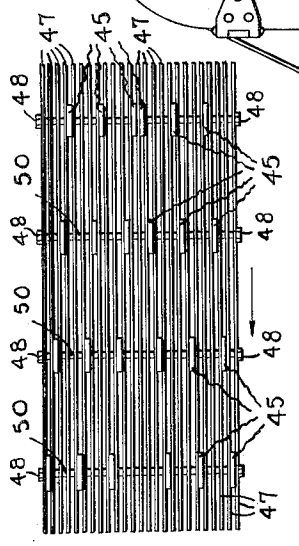


FIG. 7.



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HAMMER MILL

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FIG. 3.

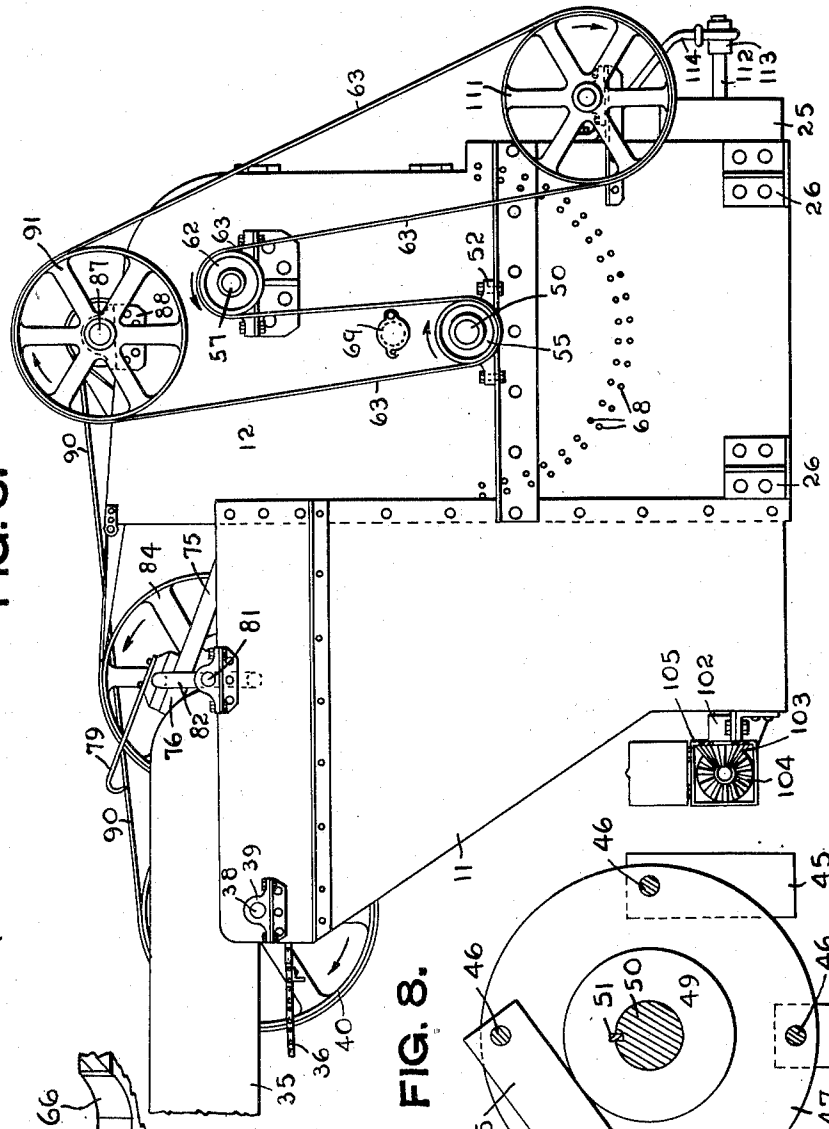
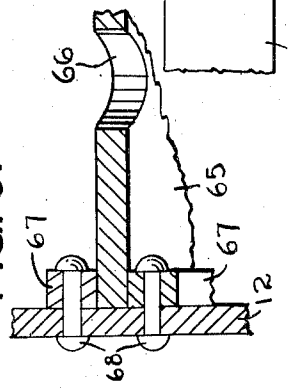


FIG. 8.

FIG. 9.



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HAMMER MILL

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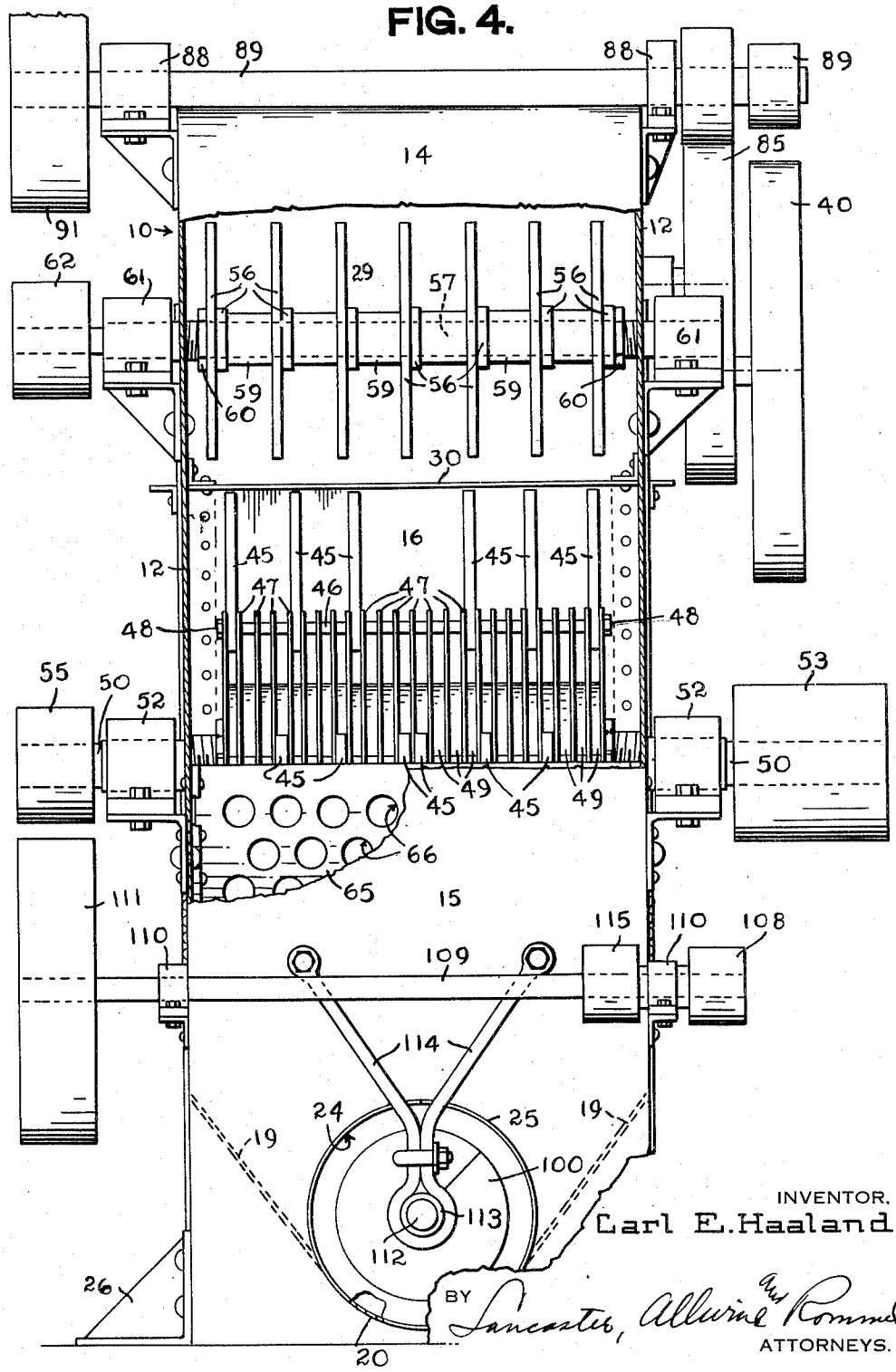
FIG. 4.



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Patented Feb. 21, 1939 2,148,022

UNITED STATES PATENT OFFICE

2,148,022

HAMMER MILL

Carl E. Haaland, Marysville, Wash.

Application March 16, 1937, Serial No. 131,235

3 Claims. (Cl. 83—11)

This invention relates to hammer mills, and more particularly to hammer mills adapted to handle material such as hay, straw, dry stalks and similar dry roughage.

An important object of the invention is to provide a hammer mill wherein the hammers are neither rigidly secured nor are they flexible, but are of rigid material and pivoted to operate by centrifugal force. As a result, they have a greater efficiency than do rigidly secured hammers and, at the same time, they do not become entrangled as do flexible hammers.

Another important object is to provide a hammer mill for material of the character named, wherein the dry leaves, such as those of alfalfa, clovers and other Fabaceae are removed prior to the hammering of the stems and stalks. This obviates powdering of the leaves, which powdering is undesirable, since such leaves are much better feed when they are whole.

Still another important object is to provide a mill, as described, which will mix such whole leaves with the material after the latter has been reduced by the hammers, so that the feed will comprise a mix of the leaves and hammered material.

Since wear and tear is an important consideration in the operation and maintenance of hammer mills as described, another important object is to provide hammers and associated parts which do not touch nor rub against each other during operation of the mill.

Hammer mills are generally subject to considerable vibration and an important object of the invention is to provide such a mill, where vibrations are reduced. This is due, not only because of a sturdy construction, but because of the specific shape and disposition of the hammers in their association with the adjacent structure of the mill.

Another object is to provide a sturdy mill structure which will not be apt to be damaged in the event hard materials, such as stones, enter the mill. There are no knives nor cutter bars employed in the construction and, consequently, there is no need to resharpen or replace such parts.

It has been discovered that, in some hammer mills, there is somewhat of an absence of synchronism between the feeding mechanism and the disintegrating means. In the novel mill herein disclosed, the feeding means cooperates with the disintegrating means in such a way that there will be no serious clogging of the mill.

Still another important object is to provide a hammer mill for material, such as dry clover, hay, alfalfa and the like, which will disintegrate the material without creating dust. This is due, in part, to the separate removal, by the mill, of most of the leaves, seeds and the like, before the material reaches the hammers.

Other objects and advantages of the invention will be apparent during the course of the following detailed description, taken in connection with the accompanying drawings, forming a part of this specification and in which drawings:—

Figure 1 is a vertical longitudinal section of the novel mill.

Figure 2 is one side elevation thereof.

Figure 3 is an opposite side elevation of the same.

Figure 4 is an elevation of the discharge end of the novel mill, parts being broken away in order to better illustrate portions of the interior structure.

Figure 5 is a top plan view of the material-receiving portion of the mill.

Figure 6 is a fragment of structure associated with the portion shown in Figure 5.

Figure 7 is a developed view of the hammer assembly of the novel mill.

Figure 8 is a side elevation of the hammer assembly, with the hammers at rest.

Figure 9 is a fragmentary section of a screen forming a portion of the mill assembly.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention and wherein similar reference characters designate corresponding parts throughout the several views, the novel mill is shown as including a housing or frame 10, preferably comprising a plurality of sections, bolted or otherwise secured together. In the example shown, each of the side walls of the housing 10 comprises a forward section 11, somewhat triangular in shape, and a rearward section 12, somewhat rectangular in shape, while the forward end wall 13, joining the forward section 11, slopes inwardly from its upper end, for a purpose later described. The rearward end wall may comprise several stepped sections 14 and 15. Disposed intermediate the forward end wall 13 and the sections 14 and 15, is a vertical partition, preferably comprising two stepped sections 16 and 17, corresponding somewhat to the sections 14 and 15, but the section 16 does not extend upwardly as far as the top of the housing. This top is partly closed by a roof or upper wall 18, supported by the rearward sections 12 of the side walls and this roof 18 covers, preferably, only that portion of the interior of the housing within these sections 12.

Extending from one side wall, comprising one of the sections 11 and 12, to the opposite side wall, comprising the other sections 11 and 12, are a pair of converging substantially straight walls 19 which join each other in a curved wall section 20, this curved section being preferably rather close adjacent the bottom of the housing, while the walls 19 join the sections 11 and 12 nearest the bottom of the housing, particularly as shown in full lines in Figure 1 and in dotted lines in Figure 4. These walls 19, with the curved section 20, provide a trough 21, for a purpose later described in detail. One end of this trough 21 is closed by a wall 22 which joins the lower extremity of the forward end wall 13, and is provided with an opening 23. The opposite end of the trough 21 is open, for there is a substantially circular opening 24 in the section 15 of the rearward end wall, with its axis coincidental with the axis of the opening 23. The arc of the opening 24 is substantially that of the curved section 20, as shown in Figure 4. An outwardly extending collar 25 may extend about the opening 24, all for a purpose later set out in detail.

Suitable braces 26 for the side walls of the housing may be provided, preferably comprising L-shaped members having web portions joining the L-shaped members, as shown in Figures 3 and 4.

From the construction thus far described, there are provided two major compartments or chambers within the housing 10,—one, the forward compartment or chamber 27, being open at its top and defined by the forward end wall 13, side sections 11, partitions 16 and 17, sections 19, 20 and 22, and the other compartment or chamber 28, being the rearward one and defined by the sections 12, 14, 15, 19 and 20, roof 18, and partitions 16 and 17. Since the partition 16 does not extend to the roof 18, as described and as shown in Figure 1, there is a forward opening 29 to the compartment 28, as well as the rearward opening 24, heretofore described.

A horizontally disposed partition or platform is provided, to rest, preferably, upon the upper extremity of the partition 16 and extend into the compartment 28 a distance somewhat less than the vertical medial line of this compartment, and to jut into the compartment 27 substantially the distance the stepped partitions 16 and 17 are spaced apart. This platform 30 may be secured to the side sections 12, as by rivets 31. Since the housing walls and partitions may be subjected to the impact of hard material, such as stones, particularly the partition wall 16 and platform 30 are of heavy material.

Means for conveying roughage or dry fodder into the mill is provided and preferably comprises a substantially horizontally disposed dry fodder trough 35, carried by the housing 10 at one end thereof and disposed to empty into the open upper end of the forward compartment 27. A suitable conveyor may be associated with this trough, such as a chain belt 36, traveling over suitable sprockets 37 fixed to a shaft 38 supported by bearings 39 carried by the housing. This shaft 38 is driven by a pulley 40 in the direction shown by the arrow in Figure 2. The chain belt 36 is provided, at suitable intervals, with transversely extending cleats 41, which may be formed of angle iron. It will be noted, particularly in Figures 1 and 3, from the location of the shaft 38 and size of the sprockets 37, that the conveying means just described, conveys the rough material such as dry alfalfa, clovers or other fodder, to a point just inwardly of the forward wall 13, for it is desirable that subsequent treatment of the roughage take place at once, in order that the leaves will be removed before disintegration of the stalks and stems.

The disintegrating means for the material to be treated is disposed within the compartment 28 and includes a plurality of hammers 45. These are rigid members, each comprising an integral, substantially rectangular, length of suitable material, carried by pivot pins 46 extending through suitable perforations adjacent the inner ends of the hammers 45 and pivotally coupling the hammers to suitable supports, such as the series of spaced apart discs 47, which are provided with suitable perforations adjacent their peripheries and spaced substantially 90° apart, to accommodate the pivot pins 46. Preferably, there are four such pivot pins 46, each extending through the series of discs 47 and having screw threaded ends, accommodating suitable nuts 48.

The hammers are preferably disposed in a staggered relationship about the disc assembly, as shown particularly in Figures 4 and 7. From this latter figure, it will be seen that (at the extreme right of this figure) there are two hammers 45 pivoted to either face of one disc 47, (the middle disc) by one pivot pin 46, and that there are then four discs intervening between each of these hammers and the next two hammers carried by this pivot pin, and then three discs intervening between each of the last two hammers and the next two hammers. The adjacent six hammers, carried by the next adjacent pivot pin, are staggered with relation to the arrangement of hammers described, and this applies to the other two groups of fixed hammers, each carried by the two other pivot pins. While this arrangement may be varied, that shown has been found, in practice, a very desirable one.

The discs 47 are spaced apart by suitable spacers 49. These are of slightly more peripheral width than the thickness of the hammers 45 and are of less diameter than the diameter of the discs 47, as may be seen particularly in Figure 8. This arrangement provides for free play of the hammers 45 and permits them, when the mill comes to a stop, to drop into the grooves provided by the adjacent discs 47 and spacers 49, thus clearing the surfaces of the hammers as well as the walls of the grooves of any foreign material which had accumulated thereon.

The discs 47 and spacers 49 are mounted upon and secured to a shaft 50, by any approved means, such as the key 51. This shaft extends across the chamber 28, from one housing section 12 to the other housing section 12 and is disposed so that, preferably, the hammers 45 when thrown outwardly by centrifugal force, will just clear the horizontal plane of the platform 30, as may be seen in Figure 1. The shaft 50 extends outwardly of the housing, through suitable perforations therein and is supported by bearings 52 which may be carried exteriorly of the housing.

At one end, the shaft 50 terminates in a pulley 53 which may be operatively connected with a suitable source of power, such as by the main drive belt 54, the pulley 53 rotating counterclockwise as viewed in Figure 2.

The opposite end of the shaft 50 terminates in a second pulley 55, being operatively connected with a portion of the mill to be next described.

Spaced above the hammer-disc-spacer assembly just described, is a combined beater and de-

flector assembly, preferably comprising a plurality of rigid, straight arms 56, provided with perforations midway thereof so that they may be mounted upon a suitable shaft 57 and secured thereto, as by a key 58, with each adjacent arm 56 normal to the next arm 56. Thus, each two adjacent arms form substantially a Greek cross and each two of such arms, may be spaced apart as by spacers 59 disposed about the shaft 57. The arm and spacer assembly may be prevented from moving longitudinally of the shaft 57, as by suitable nuts 60, cooperating with screw threads upon the shaft 57. The shaft 57 extends across the chamber 28, paralleling the shaft 50, and projects outwardly of the housing section 12, where suitable bearings 61, mounted exteriorly of the housing, accommodate it. At one end of the shaft 57, corresponding with the end of the shaft 50 carrying the pulley 55, is disposed a pulley 62, which is operatively connected with the pulley 55, as by a belt 63 disposed, as is well known in the art, so that as the shaft 50 and pulley 55 rotate in one direction, the shaft 57 and pulley 62 will travel in the opposite direction, as shown by the arrows in Figure 3.

Extending across the lower portion of the chamber 28 from one section 12 to the opposite section 12 of the housing, and from the section 14 to the section 16, at substantially the stepped portions of these sections with their associated sections 15 and 17, is an arcuate screen 65. The arc described by this screen and its direction is such that the hammers 45 when extended outwardly by centrifugal force, will clear the upper face of the screen 65. This screen is preferably of somewhat flexible material, having a plurality of spaced apart perforations 66 and suitably carried by the housing, as by a pair of spaced apart, arcuate members 67 secured to the inner faces of the sections 12, as by rivets 68, particularly as shown in Figure 9. The opposite ends of the screen 65 extend into the space between the spacing pairs of members 67.

So that the pivot pin 46 may be readily removed, in order to replace the hammers 45, a suitable opening 69 is provided in each housing section 12, with the axis of the opening coincident with the longitudinal axes of the pivot pins 46, as one after the other of the pivot pins moves with the rotation of the shaft 50.

Novel means for urging the fodder or roughage from the conveying means to the disintegrating means is shown, particularly in Figures 1, 5 and 6. This includes a plurality of spaced apart, substantially straight arms or members 75 arranged in substantial parallelism with their forward ends 76 extending towards the conveying means and disposed at the upper end of the compartment 27, and with their rearward extremities 77 extending toward the disintegrating means and disposed within the compartment 28 and adjacent the opening 29 therein, through which opening they extend. Each arm may carry a suitable removable bearing 78 at its forward end 76 as well as one or more prongs or hook-shaped teeth 79, which preferably extend outwardly along the longitudinal axis of the arm 75 and may be mounted upon the bearing 78, as is the uppermost prong 79, or mounted upon the lower face of the arm 75, as is the lowermost prong 79. Extending along the under side of each arm 75 is a plurality of spaced apart prongs or teeth 80, preferably set at such an angle with the arm 75 that they normally point downwardly and towards the rear end 77 of the arm 75.

Each arm 75 is carried by a crank shaft 81. It is preferred that the crank shaft have as many throws 82 as there are arms 75. In the example shown, particularly in Figure 5, there are four arms 75 and four throws to the crank shaft, each throw being spaced substantially 180° from the one next to it. This crank shaft 81 is rotatably carried by bearings 83, mounted upon the upper extremities of the walls 11. One end of the crank shaft 81 terminates in a pulley 84, turning in a clockwise direction, as viewed in Figure 2. This pulley 84 may be turned by a cross belt 85, extending over a pulley 86, of smaller diameter than the pulley 84. The pulley 86 is carried by a shaft 87 extending through suitable bearings 88, preferably mounted on each of the sections 12 at the top wall 18. This shaft 87 carries a second or conveyor-means-driving pulley 89, adjacent the pulley 86, which pulley 89 carries a belt extending to and about the pulley 40, which is fixed to the shaft 38 as described. It will be noted in Figure 2, that the diameter of the pulley 40 is considerably greater than that of the pulley 89, with which it is operatively connected.

The shaft 87 may extend over the roof 18 and terminate at its end opposite that upon which the pulley 89 is mounted, in a third pulley 91 about which extends the belt 63, which is also operatively connected with the pulley 55 associated with the hammer disc and spacer assembly, as well as associated with the pulley 62 which forms a portion of the beater and deflector assembly. The disposition of the belt 63 is best shown in Figure 3, and it will be noted therein that while the pulley 55 is rotating clockwise, the pulley 91 and its shaft 87 is also rotating clockwise and that the pulley 91 is of considerably greater diameter than either of the pulleys 55 and 62.

Again referring to the arms 75 of the means for urging the fodder from the conveying means to the disintegrating means and particularly shown in Figures 1, 5 and 6, the rearward end 77 of each arm 75 is pivotally connected to one end (the lower end) of a pair of upwardly extending links 92, as shown in Figure 6. At their opposite or upper ends the links 92 are pivotally connected to a suitable member, such as a rod or rods 93, extending across the chamber 28 towards the sections 12 but free of these sections. Preferably, at least a pair of links 94 extend from the rod 93 upwardly and towards the opening 29 where they may be pivotally supported by ears 95 or other suitable rigid fittings, through which and the links 94 extend bolts or other means to pivotally connect them with the rigid fittings mentioned. The rod 93 also carries one or more upwardly extending members, each of which may be a short rod 96, having an eye at its lower end encircling the rod 93 and provided with screw threads at its upper end, which end protrudes through a suitable perforation in the roof 18, where the rod 93 terminates in a nut 97 or other enlargement of greater diameter than the perforation mentioned in the roof 18.

With the arrangement of parts described, it will be noted that there will be a forward and backward movement of the arms 75 as well as an upward and downward motion, so that the forward ends 76 of the arms 75 will describe arcuate paths, substantially as shown in dotted lines in Figure 1. Thus, the arms 75, at their forward ends, will descend upon material discharged from the conveying means and will then drag such material progressively, with a shaking motion,

towards the disintegrating means, the prongs 79 and 80 aiding in this dragging motion. This motion is not merely a jerking one (whereby the material would be jerked, with the stalks of the material substantially normal to the side wall, i. e., as it is ordinarily discharged by the conveying means) but rather a motion whereby the material is jerked so that, as it travels toward the disintegrating means, first one end of the stalk is nearest the disintegrating means and then the other end moves nearest such said means. With this motion the material travels progressively towards the disintegrating means and, in addition, because of the zig-zag, shaking motion described, leaves are caused to be shaken from the stalks and stems of the material and drop downwardly.

In order to provide a surface over which the material may travel from the conveying means until it reaches the horizontal platform 30, a substantially horizontally disposed platform 98 is provided, extending from the end wall 13 to the platform 30 (of which it may be said to form a continuation) and from one side section 11 to the other side section 11. This platform is preferably disposed a short distance below the lower run of the chain belt 36 and below the lowermost path of the arms 75, as shown particularly in Figure 1. This platform 98 is preferably made up of a plurality of spaced apart rods or slats, extending longitudinally of the mill, so that leaves may drop, through the spaces between adjacent rods, into the chamber 27 below the platform.

Referring to Figure 1, it will be noted that there is a rocking motion of the links 92, indicated by the dashes, as the arms move, urged by the crank shaft 81, and there is also a possible up-and-down motion of the rearward ends 77 of the arms 75. This up-and-down motion provides for such emergency as when an unusually large amount of material may seek to pass under the rearward ends 77 of the arms. In such a case, upward movement of that end of the arm 75 will cause the short rods 96 to move upwardly, protruding from the roof 18 of the housing, where they will remain until the emergency is passed, whereupon the rods 96 will move downwardly until stopped by the enlargements 97. Thus, these rods, as they protrude, provide a signal for the operator, who may not be in a position to observe conditions at the forward end of the mill, and he will be advised that material is accumulating under the rearward ends of the arms or that the conveying means is feeding too fast. The assembly of links 94 and short rods 96 is not the equivalent of a coil spring or other resilient means. Such resilient means does not function properly after being in use for some time, coil springs soon have the spaces between their convolutions filled with material disintegrated by the mill and are inclined to bend and twist. However, the size of the various pulleys is such that there will be a synchronism of the various portions of the mill so that the material will be generally handled in a steady, even way.

From the description of the housing, particularly that of the converging sections 19 and curved section 20 forming the trough 21, as well as the inclined wall 13, the leaves and similar material dropping between the rods, from the platform 98, will either drop directly into the trough 21 or will slide down the inclined wall 13 and be deposited in the trough 21. In addition to this, the stalks and stems disintegrated by the hammers 45 and beater arms 56, will drop through the screen 65 and be deposited in the trough 21. In order to convey and mix these two materials, a screw conveyor 100 may be provided, extending longitudinally of the trough 21, with the forward end 101 of its shaft extending through the perforation 23 in the wall 22 and being carried by a suitable bearing 102 terminating in, preferably, a bevel gear 103. This bevel gear 103 meshes with a companion bevel gear 104, both of which may be protected by a suitable housing 105. The gear 104 is operatively connected with a suitable pulley 106, exterior of the housing 105, from which may extend a belt 107 to a pulley 108 carried by a shaft 109 extending transversely of the mill exteriorly of the section 15 of the rearward end wall of the housing. This shaft 109 is carried by a suitable bearing 110 and terminates at its other end in a pulley 111, operatively connected with the belt 63, as shown particularly in Figure 3, where it will be seen that the pulley 111 rotates clockwise, as viewed from said figure.

The rearward end 112 of the screw conveyor shaft projects outwardly of the collar 25 and is carried by a suitable bearing 113 and an arm 114 extending therefrom which may be secured to the housing upon the section 15 thereof.

With the arrangement of gears 103 and 104, pulley 106, belt 107, pulley 108, shaft 109 and pulley 111, which latter is operatively connected with the main drive as described and illustrated, there is a motion imparted to the material in the trough 21 so that it will finally emerge from the collar 25 in a thoroughly mixed condition.

Inwardly of one wall 12, the shaft 109 may carry a third pulley 115 so that a belt 116 may extend about this pulley and be operatively connected with a suitable conveyor means for the disintegrated fodder, so that the latter may be conducted from the point of discharge (the collar 25 or opening 24) to a location for sacking, storage or the like. This means may consist of a conventional elevator 117, shown in Figure 2.

The material disintegrated by the hammers 45, assisted by the beater arms 56, will be in a fine condition, since the fodder or roughage delivered by the arms 75, is immediately beaten into the path of the hammers 45 by the arms 56, which strike the material and break it up, drive it against the section 14 of the housing and then force it over the upper surface of the screen 65. Such material as does not drop immediately through the screen openings 66, is again forced upwardly against the partition 16 and under side of the platform 30, then thrown into the path of the beater arms and again beaten down again into the path of the hammers.

The hammers 45, being rigid in themselves but pivotally carried, and being rectangular, strike the stalks and stems normal to the length of the same and, being rigid, do not become entangled with the material or with themselves, as is sometimes characteristic of flexible hammers. Being pivotally carried and disposed as set out with relation to the discs and spacers, they are self-cleaning as has been described. In addition to the closure 69 described, for the openings in the sections 12, other openings and closures may be provided in the walls and sections of the housing, so that other portions of the interior mechanism of the mill may be readily reached.

Various changes may be made to the form of invention herein shown and described, without

departing from the spirit of the invention or the scope of the claims.

What is claimed is:

1. In a roughage disintegrating mill, a housing having a perforation extending from its interior to its exterior; roughage conveying means supported by said housing; roughage disintegrating means carried by said housing; and means for urging roughage from said conveying means to said disintegrating means, including a plurality of spaced apart arms provided with teeth at their free ends and a plurality of teeth extending longitudinally along the under sides of said arms, a crank shaft having a plurality of throws, spaced apart about said crank shaft, said arms being pivotally mounted upon said throws intermediate the ends of said arms, a plurality of links, one for each arm and each pivoted at one end to its arm adjacent the end of said arm opposite said free end, an arm pivoted at one end to said housing, a pivot pin pivoting the opposite ends of said links to said last named arm, at the end of said last named arm opposite its pivotal connection with said housing, a suspender pivoted at one end to said pivot pin and extending upwardly and outwardly of said housing, being slidable through said perforation in said housing, and an enlargement upon the outwardly protruding end of said suspender, said enlargement being of greater diameter than the diameter of said perforation.

2. In a roughage disintegrating means particularly adapted for disintegrating leaf-bearing dry roughage, a housing; roughage conveying means supported by said housing; means for urging roughage from said conveying means and for removing leaves therefrom, including a plurality of spaced apart, substantially straight arms, arranged in parallelism, one with another, roughage engaging members at the free ends of said arms, the free ends of said arms being disposed nearer said conveying means, a crank shaft carried by said housing and having at least two throws, with said arms pivotally mounted upon said throws intermediate the ends of said arms, a plurality of links pivotally secured at one end to said arms opposite the free ends thereof, said links being pivotally carried at their other ends by said housing; a horizontally disposed platform provided with a plurality of vertical openings, said platform extending from said conveying means to a position beneath said arms, the relationship of said platform to said arms being such that as roughage is deposited upon said platform by said conveying means, said arms will first descend upon it and engage it with said roughage engaging members and then draw said roughage over said platform away from said conveying means; roughage disintegrating means, operatively carried by said housing in a position to receive said roughage from said arms, and mixing means below said platform and said disintegrating means, disposed to receive said leaves and the disintegrated roughage from said disintegrating means.

3. In apparatus for reducing vegetation of a character including appendage-carrying stems, means for separating the appendages from the stems, means for reducing the stems after the appendages have been separated therefrom, a trough positioned below the separating and reducing means and into which the appendages and the reduced stems may fall, said trough being provided with an outlet at one end portion, a spiral worm positioned longitudinally in the trough, and means for rotating the worm so as to urge the appendages and the reduced stems toward the outlet end portion of the trough and whereby the appendages and the reduced stems will tend to leave the trough in a homogeneous mixture.

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