Sept. 28, 1948. C. E. FRUDDEN 2,450,277

FORAGE CUTTING APPARATUS, INCLUDING A ROTOR HAVING POCKETED BLADES

Filed Oct. 1, 1945

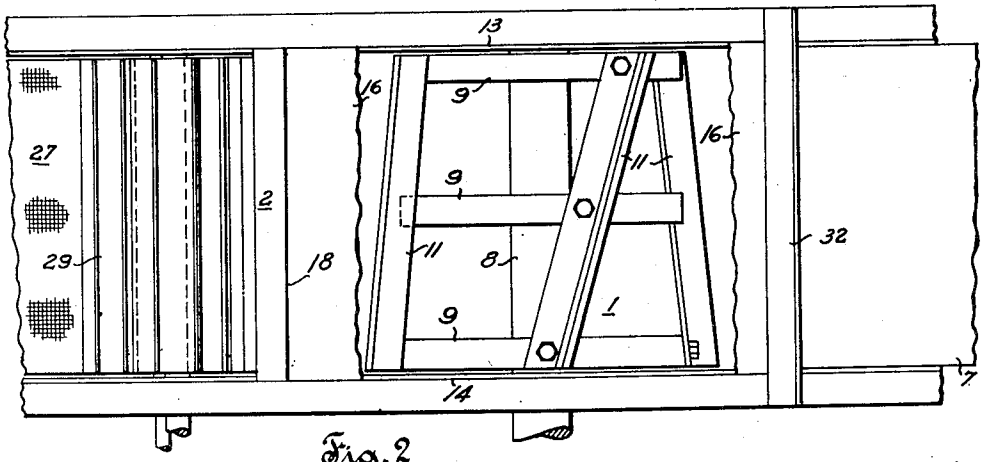


Fig. 2

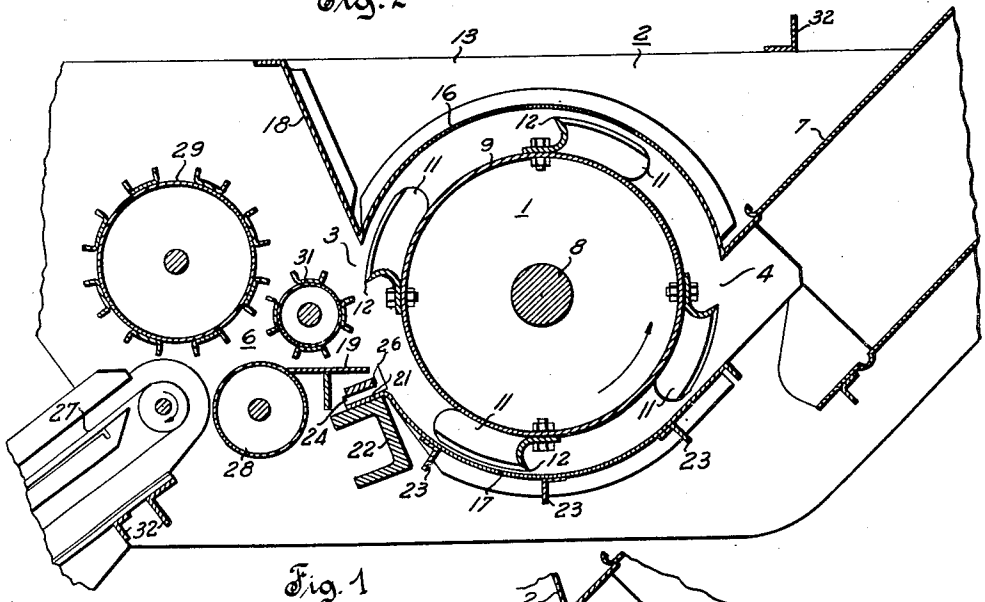


Fig. 1

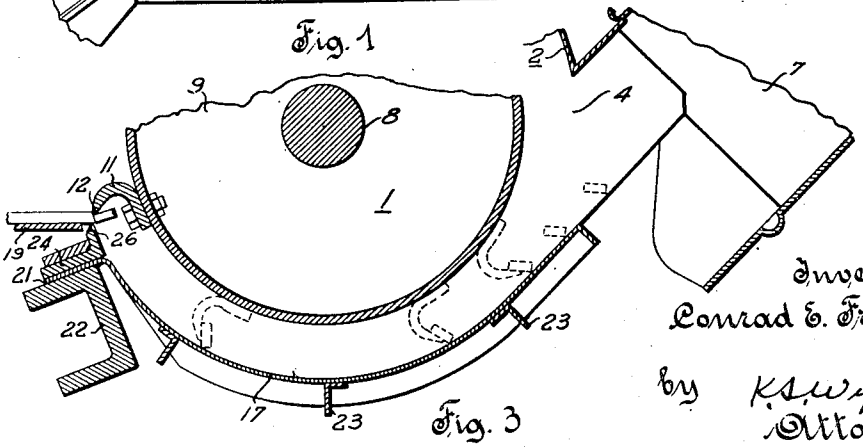


Fig. 3

Inventor
Conrad E. Frudden

by K. S. Wyman
Attorney

Patented Sept. 28, 1948 2,450,277

UNITED STATES PATENT OFFICE

2,450,277

FORAGE CUTTING APPARATUS, INCLUDING A ROTOR HAVING POCKETED BLADES

Conrad E. Frudden, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis., a corporation of Delaware

Application October 1, 1945, Serial No. 619,633

9 Claims. (Cl. 146—120)

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This invention relates generally to forage reducing machines of the type embodying rotor mounted blades coacting with a shear bar or other suitable device for effecting a severing of the material normally fed into such machines, and has for its object the provision of an improved forage severing and conveying apparatus affording one or more of the following advantages: (1) an effective cutting and conveying of the severed material with a minimum number of parts, (2) low power requirements, and (3) a simple, durable construction requiring a minimum of servicing in order to maintain the severing parts conditioned for effective operation.

More particularly, the present invention is directed toward and contemplates the provision of a forage reducing and conveying apparatus wherein the material is severed within or adjacent an opening in a casing structure and then conveyed through the casing structure to a discharge opening therein by means of a rotor having one or more trough-shaped blade elements extending generally longitudinally of the rotor axis and presenting a concave paddle portion and an outer knife-like cutting edge, both facing in the general direction of blade travel.

The knife-like cutting edge coacts with a shear bar or like part and serves to effectively sever the material fed into the machine, and the forwardly facing concave, trough-like paddle portion serves to impart a high velocity to the severed material in conveying same to and through the discharge opening in the rotor enclosing casing and serves to reduce friction losses by minimizing the rubbing or scrubbing action of severed material on the peripheral confining wall of the casing structure.

In the heretofore known constructions of forage reducing machines, it is common practice to use rotor mounted knife elements presenting a forwardly facing cutting edge and to employ an additional set of separate material-conveying paddle elements mounted either on the knife carrying rotor or on a separate rotor in order to impart a high velocity to the severed material in conveying same to and through the discharge opening in the rotor enclosing casing structure. However, the provision of an additional set of material conveying paddle elements increases the cost of constructing and operating such machines, and in addition, the separate paddle elements are in general arranged and/or shaped so as to increase, rather than minimize, the friction loss and wear of parts resulting from severed material rubbing against or scrubbing the peripheral confining wall of the casing structure.

In accordance with this invention, each rotor mounted blade-like element effectively serves the dual purpose of severing the material and then conveying the severed material to and through

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the discharge opening in the rotor enclosing casing structure thus minimizing the number of rotating parts required, the friction loss and wear of parts, and consequently the initial, operating and servicing costs.

The construction, application and operation of apparatus embodying the invention will become readily apparent as the disclosure progresses and more particularly points out features of construction considered of special importance. And in this connection, the present invention may be considered as consisting of the various combinations of elements and parts constructed and/or correlated as is more fully set forth in the detailed description and in the appended claims, reference being had to the accompanying drawing illustrating an embodiment of the invention and in which:

Fig. 1 is a longitudinal section through part of a forage harvester embodying the invention;

Fig. 2 is a partial plan view of the structure shown in Fig. 1 with parts broken away to better show the arrangement of parts;

Fig. 3 is an enlarged partial longitudinal section illustrating the coaction between the oppositely facing knife-like cutting edges of the blades and shear bar, and the manner in which severed material is partially pocketed in the concavity of a blade as it is conveyed to the discharge opening in the rotor enclosing casing.

Referring to Fig. 1 of the drawing, it is seen that for purposes of illustration the invention is shown as applied to a forage reducing machine of the type including a rotor 1, a casing structure 2 enclosing the rotor 1 and provided with a pair of circumferentially spaced elongated openings 3 and 4 extending in generally parallel relation with respect to the rotor axis, a material feeding mechanism 6 operatively associated with the opening 3, and a material receiving conductor or spout structure 7 enclosing the opening 4.

The rotor 1 comprises a shaft portion 8, a plurality of peripherally flanged disks 9 disposed on shaft portion 8 in concentric relation thereto and in axially spaced relation with respect to each other, and a plurality of trough-shaped blade elements 11 secured to the peripheral flange portions of the disks 9 in circumferentially spaced relation with respect to each other and with the concave surfaces of the blades facing in the general direction of blade travel or rotor rotation as is clearly indicated by the arrow on Fig. 1. The outer portions of the blades are sharpened to present knife-like cutting edges 12 which also face in the general direction of blade travel and in this connection, are preferably externally beveled in order to permit the blades to be readily effectively externally ground or resharpened while the rotor is revolving. The blades are preferably secured to the disks 9 in skewed relation rela-

tive to the rotor axis, as is clearly shown in Fig. 2, in order for the sharpened outer edges of the blades to progressively move into a cutting relation with respect to a shear bar or like part disposed in generally parallel relation with respect to the rotor axis.

Referring to Figs. 1 and 2, it is seen that blades 11 are of uniform thickness throughout except at the outer edges which are ground to provide knife-like cutting edges 12, disposed in leading relation in the direction of travel to the concave material confining portion, that the base portion of the blades 11 are fixedly secured to peripheral portions of flanged disks or support members 9 as by bolts and nuts, that the securing connection between blades 11 and flanged disks 9 are disposed in leading relation to an adjacent portion of the cutting edge 12.

The casing structure 2 comprises a pair of preferably parallel end walls 13 and 14 rigidly interconnected by means of upper and lower arcuate wall sections 16 and 17 circumferentially spaced apart to form therebetween the material receiving and discharging openings 3 and 4, respectively, and by means of a material directing wall 18 which extends upward and forward from the edge of upper section 16 which in part defines the material receiving opening 3. In addition, the end walls 13 and 14 may be also rigidly interconnected by means of a ledge plate structure 19 disposed adjacent the edge of the opening 3 defined by the outwardly flanged edge 21 of lower arcuate section 17, and by means of a U-shaped channel member 22 disposed in underlying supporting relation with respect to the flanged edge 21 of lower section 17. And if desired, lower section 17 may be additionally reinforced by means of a plurality of external angle members 23 disposed in approximately parallel relation with respect to the rotor axis.

In addition to affording a support for the flanged edge 21 of lower section 17, channel member 22 also supports a shear bar or like part 24 disposed in superposed relation with respect to flanged edge 21 and in suitable coacting relation with respect to the sharpened outer edges 12 of the rotor mounted knife blades 11. In this connection, shear bar 24 is preferably shaped and sharpened to present a knife-like cutting edge 26 which is disposed adjacent the casing edge of ledge plate 19 and faces in a direction generally opposite to the knife-like cutting edge presented by each blade 11 when disposed in material severing relation thereto.

The material feeding mechanism comprises an endless elevating conveyor 27 arranged to deliver material to be severed onto a plain surfaced roll 28 effectively closing the space between the discharge end of conveyor 27 and ledge plate 19, a relatively large ribbed feed roll 29 disposed in overlying coacting relation with respect to the upper discharge end of conveyor 27 and with respect to feed roll 28, and a smaller ribbed feed roll 31 disposed alongside roll 29 in overlying coacting relation with respect to a portion of roll 28 and with respect to ledge plate 19. The effective width of the upper or discharge end of conveyor 27 is approximately equal to the length of the associated feed rolls 28, 29 and 31 and to the distance between the end walls 13 and 14 of casing structure 2. And the feed rolls are preferably of a length approximately equal to the effective length of ledge plate 19, to the effective length of the elongated material receiving opening 3, and to the effective length of rotor 1.

The discharge end of conveyor 27 is disposed between the casing structure end walls 13 and 14 and is supported, at least in part, by one or more cross members 32 which may be carried by the end walls 13 and 14 or by any other suitable parts of the casing structure, as desired. And it is to be understood that the rotor 1, the rotating parts of conveyor 27 and the feed rolls 28, 29, and 31 are operatively mounted and driven in a known manner by means of conventional bearing supports and by means of conventional driving connections with a suitable power source (all not shown in the interest of simplicity), and that the casing structure 2 may be in turn suitably mounted on any desired form of supporting structure.

In operation, material to be severed passes from the discharge end of conveyor 27 between the rolls 28 and 29, then between the roll 31 and ledge plate 19, and then over the knife-like cutting edge 26 of shear bar 24 and into the material receiving opening 3. In passing over the knife-like cutting edge 26, the material is effectively severed through coaction of the forwardly facing knife-like cutting edges 12 presented by the rotating blades 11. And the severed material is then engaged by the forwardly facing concave paddle portions of the blades and is conveyed thereby at high velocity to and through the discharge opening 4 and into the spout structure 7.

In this connection, much of the severed material is pocketed within the concavity of the trough-like blade while being conveyed to its point of discharge (see Fig. 3), and is thus prevented from rubbing against or scrubbing the confining wall surface presented by arcuate section 17. Moreover, arcuate section 17 closely surrounds the outer peripheral portions of the blades and thus prevents severed material from escaping or passing between the sharpened outer edge of the blades and the confining wall structure. In addition, the passage of severed material at high velocity through discharge opening 4 and into spout 7 extending tangentially upward and away from the casing in the general direction of material projection affords an effective means for conveying comminuted material to an elevated point of disposition, for example, into a trailing wagon or other suitable receptacle (not shown) without the aid of an auxiliary conveying means such as a blower or a paddle type conveyor heretofore commonly employed, all to the end of affording a simplified and durable construction which is relatively inexpensive both as to manufacture and operation.

The invention is in general applicable to all types of forage reducing machines embodying a casing enclosed rotor element for severing material delivered thereto and for conveying the severed material to a point of discharge comprising an opening in the casing structure. And while the invention has been illustrated and described as applied to a forage harvester of the type embodying an elevating conveyor and a feed roll assembly, it should be understood that it is not intended to limit the invention either to its use for reducing and conveying forage in particular or to the particular combination of elements herein shown and described for purposes of illustration as various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. A forage severing and conveying apparatus

comprising a shaft, a plurality of peripherally flanged disks mounted on said shaft in concentric relation thereto, one or more trough-shaped blades secured to peripheral flange portions of said disks and extending generally longitudinally of the shaft axis with the concave material confining surfaces of said blades facing in the general direction of blade travel, said blades each having its outer edge portion externally beveled and sharpened to present a knife-like cutting edge which also faces in the general direction of blade travel, a casing structure surrounding the outer edges of said blades and having therein a pair of circumferentially spaced material receiving and discharging openings, and a shear bar mounted for severing coaction with the outer edge portions of said blades, said casing structure having an arcuate section extending from said shear bar to the adjacent side of said material discharging opening and contiguously coacting with the outer edges of said blades to prevent severed material from passing between said arcuate casing section and the opposed cutting edges of said blades thereby maintaining much of the severed material within the troughs of said blades as it is conveyed by said blades to said discharge opening.

2. A forage severing and conveying apparatus comprising a shaft, a plurality of peripherally flanged disks mounted on said shaft in concentric relation thereto, one or more trough-shaped blades secured to peripheral flange portions of said disks and extending generally longitudinally of the shaft axis with the concave material confining surfaces of said blades facing in the general direction of blade travel, said blades each having its outer edge portion externally beveled and sharpened to present a knife-like cutting edge which also faces in the general direction of blade travel, a casing structure surrounding the outer edges of said blades and having therein a pair of circumferentially spaced material receiving and discharging openings, and an angle-shaped shear bar mounted adjacent one side of said material receiving opening for severing coaction with said blades and having base and flange portions with the latter portion extending from said base portion in a direction generally opposite to the direction of blade rotation when said blades are adjacent said shear bar and having the free end of the flange portion sharpened to present a knife-like cutting edge facing in a direction generally opposite to the knife-like cutting edges of said blades when disposed in material severing relation, said casing structure having an arcuate section extending from said shear bar to the adjacent side of said material discharging opening and contiguously co-acting with the outer edges of said blades to prevent severed material from passing between said arcuate casing section and the opposed cutting edges of said blades thereby maintaining much of the severed material within the troughs of said blades as it is conveyed thereby to said discharge opening.

3. A forage severing and conveying apparatus comprising a rotor structure presenting one or more trough-shaped, peripherally disposed blades extending generally longitudinally of the rotor axis and having concave material confining surfaces facing in the general direction of blade travel, said blades each having its outer edge portion externally beveled and sharpened to present a knife-like cutting edge which also faces in the general direction of blade travel, a

casing structure surrounding the outer edges of said blades and having therein a pair of circumferentially spaced material receiving and discharging openings, and an angle-shaped shear bar mounted adjacent one side of said material receiving opening for severing coaction with said blades and having base and flange portions with the latter portion extending from said base portion in a direction generally opposite to the direction of blade rotation when said blades are adjacent said shear bar and having the free end of the flange portion sharpened to present a knife-like cutting edge facing in a direction generally opposite to the knife-like cutting edges of said blades when disposed in material severing relation, said casing structure having an arcuate section extending from said shear bar to the adjacent side of said material discharging opening and contiguously coacting with the outer edges of said blades to prevent severed material from passing between said arcuate casing section and the opposed cutting edges of said blades thereby maintaining much of the severed material within the troughs of said blades as it is conveyed thereby to said discharge opening.

4. A forage severing and conveying apparatus comprising a rotor structure, one or more blades removably attached to peripheral portions of said rotor structure and extending generally longitudinally of the rotor axis, said blades presenting trough-like material confining pockets facing in the general direction of blade travel, a casing structure closely surrounding the bladed peripheral portion of said rotor and having therein a pair of circumferentially spaced material receiving and discharging openings, and an angle-shaped shear bar mounted adjacent one side of said material receiving opening for severing coaction with said blades and having base and flange portions with the latter portion extending from said base portion in a direction generally opposite to the direction of blade rotation when said blades are adjacent said shear bar and having the free end of the flange portion sharpened to present a knife-like cutting edge facing in a direction generally opposite to the cutting edges of said blades when disposed in material severing relation, said blades each having its outer, shear-bar opposing edge portion externally beveled and sharpened to present a knife-like cutting edge which also faces in the general direction of blade travel.

5. A forage severing and conveying apparatus comprising a shaft, a plurality of peripherally flanged disks mounted on said shaft in concentric relation thereto, one or more trough-shaped blades secured to peripheral flange portions of said disks and extending generally longitudinally of the shaft axis and having concave material confining surfaces facing in the general direction of blade travel, said blades having their outer edges sharpened to present knife-like cutting edges which also face in the direction of shaft rotation, a casing structure closely surrounding the outer edges of said blades and including material receiving and discharging openings therein, and an angle-shaped shear bar mounted adjacent said material receiving opening for severing coaction with said blades and having base and flange portions with the latter portion extending from said base portion in a direction generally opposite to the direction of blade rotation when said blades are adjacent said shear bar and having the free end of the flange portion sharpened to present a knife-like cutting edge facing

in a direction generally opposite to the knife-like cutting edges of said blades when disposed in material severing relation.

6. A forage severing and conveying apparatus comprising a shaft, a plurality of support members mounted on said shaft, one of more trough-shaped blades secured to peripheral portions of said supports and extending generally longitudinally of the shaft axis and presenting the concave material confining surfaces facing in the general direction of blade travel, said blades each having its outer edge portion externally beveled and sharpened to present a knife-like cutting edge which also faces in the general direction of blade travel, a casing structure surrounding the outer edges of said blades and having therein a pair of circumferentially spaced material receiving and discharging openings, and a shear bar mounted for severing coaction with the outer edge portions of said blades, said casing structure having an arcuate section extending from said shear bar to the adjacent side of said material discharging opening and contiguously coacting with the outer edges of said blades to prevent severed material from passing between said arcuate casing section and the opposed cutting edges of said blades thereby maintaining much of the severed material within the troughs of said blades as it is conveyed by said blades to said discharge opening.

7. A forage severing and conveying apparatus comprising a rotor structure presenting one or more trough-shaped peripherally disposed blades extending generally longitudinally of the rotor axis and each blade having a concave material confining surface facing in the general direction of blade travel, said blades each having its outer edge portion sharpened to present a knife-like cutting edge which also faces in the general direction of blade travel, a casing structure surrounding the outer edges of said blades and having therein a pair of circumferentially spaced material receiving and discharging openings, a shear bar mounted adjacent one side of said material receiving opening for severing coaction with said rotor mounted blades, said casing structure including an arcuate section extending from said shear bar to the adjacent side of said material discharging opening and contiguously coacting with the outer edges of said blades to prevent severed material from passing between said arcuate casing section and the opposed cutting edges of said blades thereby maintaining much of the severed material within the troughs of said blades as the severed material is conveyed by said blades to said discharge opening, and a severed material receiving and confining spout structure surrounding said discharge opening and extending generally upwardly tangentially from the periphery of said casing structure in the direction of rotor rotation and in a direction generally conforming with the trajectory of the severed material projected through said discharge opening.

8. In a material severing and conveying apparatus comprising a rotor presenting at least one peripherally disposed material cutting and conveying blade presenting a material cutting edge disposed in leading relation in the direction of blade travel with respect to an intermediate portion of said blade to thereby define a material confining pocket facing in the direction of blade travel, a casing structure surrounding said rotor in material confining relation thereto and having therein a pair of circumferentially spaced material receiving and discharging openings, a shear bar mounted adjacent one side of said material receiving opening for severing coaction with said rotor mounted blade, said casing structure having an arcuate section extending from said shear bar to the adjacent edge of said material discharging opening and contiguously coacting with the outer edges of said blade to prevent severed material from passing between said arcuate section and the opposed cutting edge of said blade thereby maintaining much of the severed material within the confines of said blade pocket as the material is conveyed to said discharge opening, and a severed material receiving and confining spout structure surrounding said discharge opening and extending generally upwardly tangentially from the periphery of said casing structure in the direction of rotor rotation and in a direction generally conforming with the trajectory of the severed material projected through said opening.

9. In a material severing and conveying apparatus comprising a rotor, a casing structure surrounding said rotor and having therein a pair of circumferentially spaced material receiving and discharging openings, said casing structure having an arcuate section extending from a point proximate to said material receiving opening to the adjacent edge of said material discharging opening, said rotor having one or more blades presenting intermediate portions terminating in radially spaced base and cutting edge portions disposed in leading pocket forming relation in the direction of blade travel with respect to said intermediate portions, said blades being removably attached to the periphery of said rotor with the base portions of said blades in leading relation in the direction of blade travel to said intermediate and said cutting edge portions, a shear bar mounted adjacent one edge of said material receiving opening in proximate relation to said arcuate section and coacting with said blades for severing material fed therebetween, the outer portions of said blades contiguously coacting with said arcuate section to form material confining pockets facing generally in the direction of blade rotation as the severed material is conveyed to said discharge opening by said blades, and a severed material receiving and confining spout structure surrounding said discharge opening and extending generally upwardly tangentially from the periphery of said casing structure in the direction of rotor rotation and in a direction generally conforming with the trajectory of the chopped material projected through said discharge opening.

CONRAD E. FRUDDEN.

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