

[54] **FORAGE HARVESTER CUTTERHEAD**

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[51] Int. Cl. **A01d 55/18**

[58] Field of Search 83/356.3, 355, 673, 677, 83/699, 700; 56/250; 241/222, 282.1, 282.2, 277

[56] **References Cited**

UNITED STATES PATENTS

1,929,586	10/1933	Holland-Letz	83/673 X
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FOREIGN PATENTS OR APPLICATIONS

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Primary Examiner—Willie G. Abercrombie

[57] **ABSTRACT**

A forage harvester has a reel-type cutterhead having an axial shaft with a pair of disk-like radial members mounted on the shaft. A plurality of longitudinally extending, parallel, equiangularly spaced knives have flat generally radially extending inner portions and forwardly inclined outer portions with cutting edges at their outer ends generating a cylinder as the cutterhead rotates. Each knife is mounted on the cutterhead by means of a pair of support elements respectively attached to the respective radial members, each support element having a flat, generally radial seat against which the knife is clamped by a bolt extending through the knife and through a radial slot in the support element. Each knife is adjustable in a radial direction by loosening a nut on the bolt and sliding the bolt and the knife attached thereto along the support element slot, the adjustment being accomplished by rotating a cam mounted on the head of the bolt in engagement with an abutment on the support element. A radially extending set screw in the support element is engageable with the bolt to lock the bolt in the selected position.

7 Claims, 10 Drawing Figures

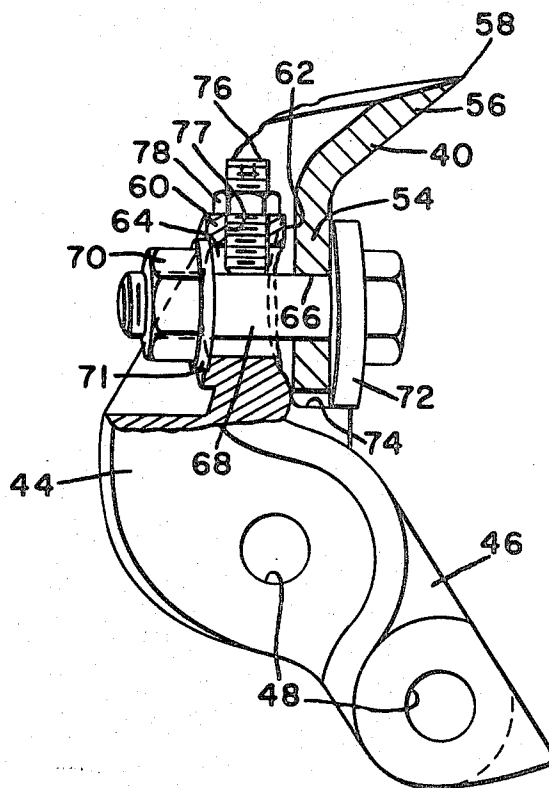


FIG. 1

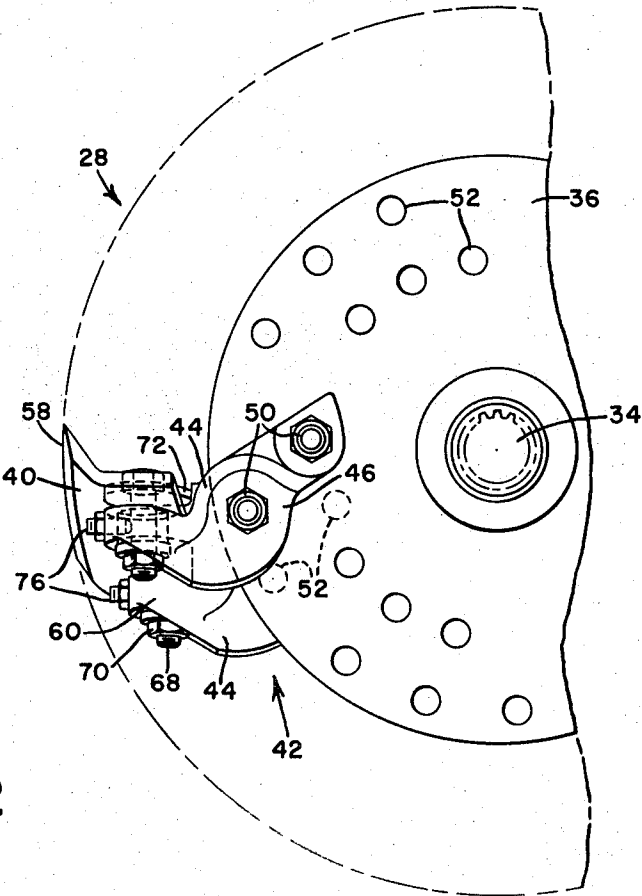
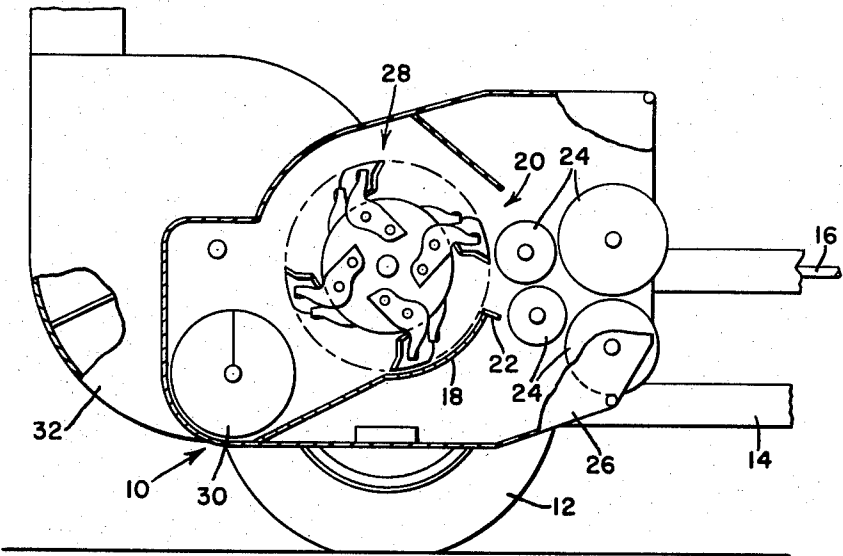


FIG. 2

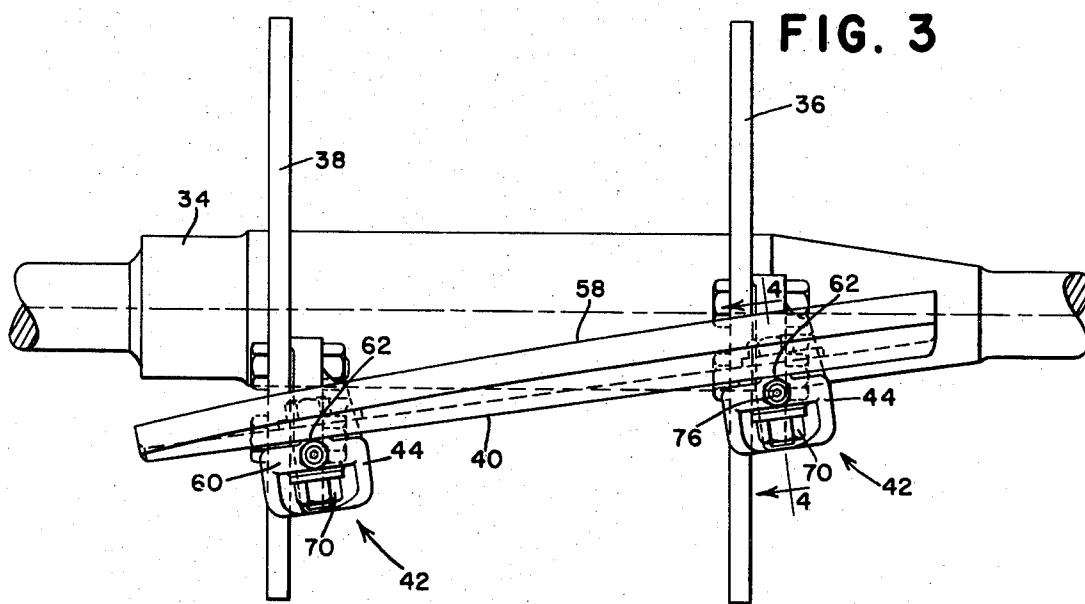


FIG. 5

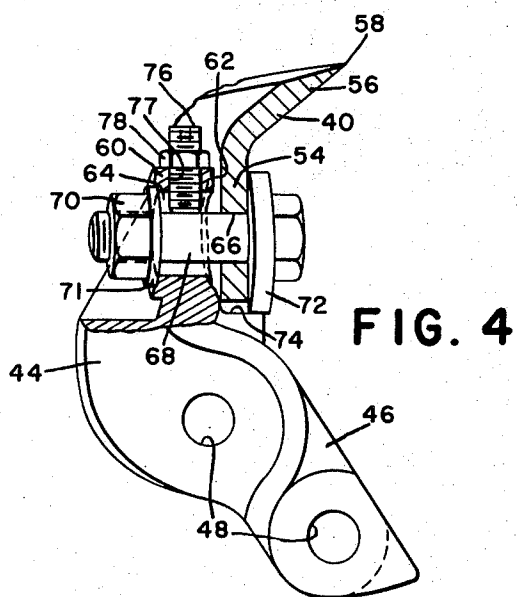
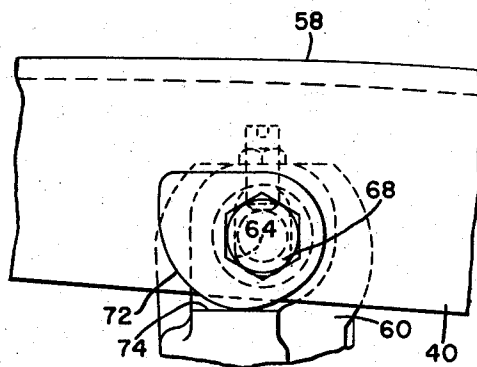


FIG. 6

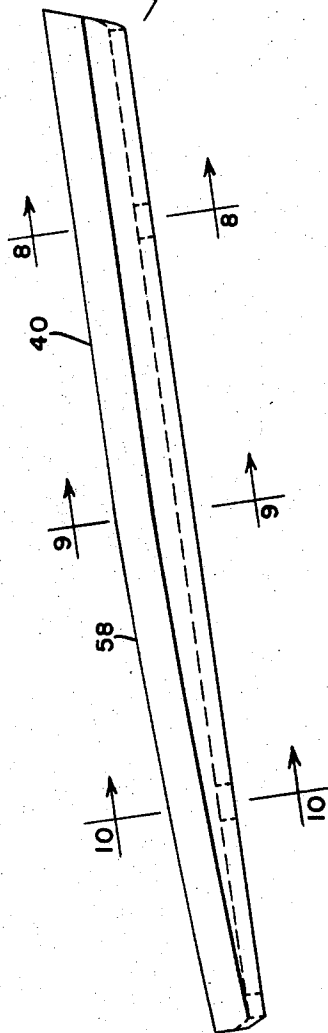


FIG. 7

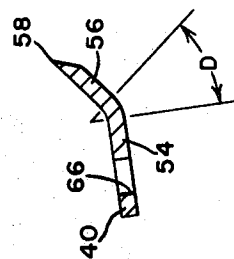
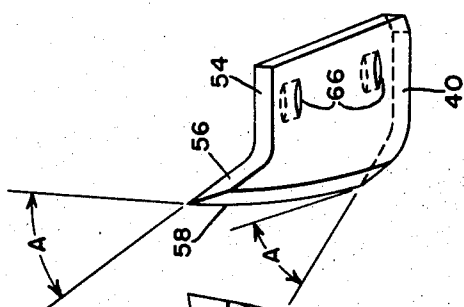


FIG. 10

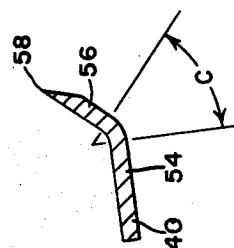


FIG. 9

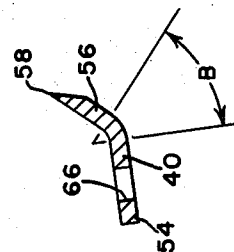


FIG. 8

FORAGE HARVESTER CUTTERHEAD

BACKGROUND OF THE INVENTION

This invention relates to a cylinder or reel-type cutterhead for a forage harvester or the like and more particularly to improved cutterhead knives and means for mounting and adjusting the knives on the cutterhead.

It is well known to provide a forage harvester with a reel-type cutterhead, which cooperates with a stationary shear bar to reduce the crop as it moves over the shear bar radially into the rotating cutterhead, such cutterheads typically having a plurality of equiangularly spaced, longitudinally extending, parallel knives with cutting edges registering with the shear bar at the cutterhead periphery. It is also known to provide means for adjusting the knives on the cutterhead so that each knife maintains a proper register with the shear bar. U.S. Pat. No. 3,452,796, issued to Hennen on July 1, 1969 and also assigned to the assignee herein, discloses such a reel-type cutterhead for a forage harvester with means for adjusting the knives on the cutterhead in a generally radial direction.

SUMMARY OF THE INVENTION

According to the present invention, improved means for adjustably mounting the knives on a reel-type cutterhead are provided. More specifically, the cutterhead is provided with knife-supporting elements having seats against which the knives are releasably clamped, and the knives are adjustable in a generally radial direction along the seats when they are unclamped.

An important feature of the invention resides in the provision of cam means for shifting the knives outwardly during their adjustment. Also according to the invention, the knives are releasably clamped to the support elements by bolts which extend through the knives, and the cam means are associated with the respective bolts to shift the bolts and the knives carried thereby in a generally radial direction in response to adjustment of the cams. Also, the cams are coaxially mounted on the bolts, so that the cams are adjusted when the bolts are rotated.

Another feature of the invention resides in the provision of knives with relatively flat radially extending inner portions which engage the support element seats, the knives also being provided with outer portions inclined in the direction of cutterhead rotation, the knife configuration providing both good cutting characteristics and blowing characteristics, so that the cutterhead adequately discharges the material after it is cut. The flat inner portion of each knife is also advantageous for the mounting and the adjusting of the knife.

Still another feature of the invention resides in the provision of means for locking the knives in the adjusted position. More specifically, a set screw is provided in each support element for engagement with the mounting bolts to prevent radial creeping of the mounting bolts and the knives carried thereby.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partly schematic vertical section of the cutterhead portion of a harvester including the improved cutterhead.

FIG. 2 is an enlarged side view of a portion of a cutterhead showing the mounting of a single knife.

FIG. 3 is a plan view of the cutterhead with a single knife mounted thereon.

FIG. 4 is an enlarged side view of one of the knife support elements with the outer portion of the support element and the knife shown in section as viewed along the line 4—4 of FIG. 3.

FIG. 5 is an enlarged fragmentary view showing the mounting of the knife on one of the support elements as viewed from the head end of the knife-mounting bolt.

FIG. 6 is a plan view of one of the knives.

FIG. 7 is an end view of the knife shown in FIG. 6.

FIGS. 8, 9 and 10 are respectively sections of the knife as viewed along the lines 8—8, 9—9, and 10—10 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention is embodied in a forage harvester having a mobile main frame indicated generally by the numeral 10 and mounted on a pair of wheels 12, the right wheel being omitted from FIG. 1 to more clearly illustrate the invention. The main frame includes a forwardly extending draft member 14, which is connectible to a tractor in the conventional manner, the harvester being powered from the tractor PTO by a fore-and-aft extending drive shaft 16.

A cutterhead housing 18 is mounted on the right side of the main frame 10 and includes a forward inlet opening 20 having a transversely extending shear bar 22 along its lower edge. Two pair of axially transverse cooperating feed rolls 24 are mounted in a feed roll housing 26 immediately in front of the cutterhead housing 18, and a harvesting attachment (not shown) is mountable on the front of the feed roll housing 26 in the conventional manner for removing the crop from the field and delivering it to the feed rolls 24. The crop passes between the cooperating feed rolls, which deliver it rearwardly through the inlet opening 20 over the shear bar 22 in a generally radial direction into a rotating cylinder or reel-type cutterhead, indicated in its entirety by the numeral 28. The cutterhead reduces the crop as it passes over the shear bar and impells it rearwardly to a transverse auger 30, which moves the crop laterally on the harvester to a blower-type elevator 32 at the left side of the machine, the blower discharging the reduced crop into a trailing collector vehicle in the conventional manner.

The cutterhead 28 includes an axial shaft 34, which is connected to and driven by the drive shaft 16 through a known type of drive mechanism (not shown), whereby the cutterhead is driven in a clockwise direction as viewed in FIG. 1. A pair of disk-like radial members 36 and 38 are coaxially mounted on and axially spaced on the cutterhead shaft 34, and a plurality of generally longitudinally extending, parallel knives 40 are equiangularly spaced about the cutterhead, each knife being respectively mounted on the radial members 36 and 38 by a pair of identical support structures indicated generally by the numeral 42. Since the support structures 42 and knives 40 are identical, only a single knife and single support structure will be described in detail.

Each support structure 42 includes a cast support element 44 having a flat inner body portion 46 extending in a generally radial plane adjacent to the associated

member. The inner body portion has a pair of bores 48 parallel to the axis of the cutterhead and each support element is removably attached to the adjacent radial member 36 or 38 by bolt-and-nut-type fasteners 50 extending through the bores 48 and through corresponding bores 52 in the radial members 36 and 38.

Each knife has a flat generally radial inner portion 54 and an inclined outer portion 56, which is angled in the direction of rotation of the cutterhead and has a cutting edge 58 at its outer end. In the illustrated embodiment, the cutting edges 58 are angled or inclined relative to the cutterhead axis at approximately an 8° angle. The helical-type knives are well known in reel-type cutterheads and advantageously provide a better cutting action in cooperation with the straight shear bar during operation. Each cutting edge 58 is in the shape of a section of an ellipse, which is formed by the angled intersection of a plane with a cylinder. Since the inner portions 54 of the knives are flat, they do not extend in an exactly radial direction throughout their length. As is apparent, the inner portion 54 extends in a substantially radial direction at the right-hand end of the cutterhead, while at the left-hand end it lies in a plane somewhat offset from the axis of the cutterhead. To accommodate the different relationship of the flat inner portion of each knife at the opposite ends of the cutterhead with the cutterhead axis, the support elements 44, which are identical, are mounted on the radial members 36 and 38 at slightly different angles. Thus, each pair of bores 52 in the member 36 has a slightly different relationship with the axis of the member 36 than the corresponding pair of bores in the member 38 has with the axis of the member 38, the pair of bores in the member 38 for the mounting of the illustrated knife being illustrated in dotted lines in FIG. 2.

Preferably, the inner or forward surface of the inclined outer portion 56 of each knife maintains the same relationship with the outer periphery of the cutterhead throughout the length of the knife. In the illustrated embodiment, said inner surface forms approximately a 40° angle with a line tangential to the cutterhead at any plane along the knife, the 40° angle being indicated by the letter A in FIG. 7 at both ends of the knife. As is apparent, to maintain the constant angle with the cutterhead periphery, the inclined outer portion must form different angles with the flat inner portion 54, the angle that the inclined outer portion 56 makes with the flat inner portion 54 at the right-hand end of the knife being substantially greater than the angle at the left-hand end of the knife. Thus, in the illustrated embodiment, the inclined outer portion 56 is bent approximately 50° relative to the flat inner portion at the right mounting point, as shown in FIG. 8, and forms approximately a 44° angle at the center of the knife, as shown in FIG. 9, while it forms only a 38° angle at the left mounting point, as shown in FIG. 10, the three different angles being respectively identified by the letters B, C and D in FIGS. 8, 9 and 10.

As is well known, different numbers of knives can be provided on the cutterheads to vary the length of the material cut for a given cutterhead speed. In FIG. 1, a four-knife cutterhead is illustrated. However, in FIG. 2, the mounting bores 52 in the radial members 36 and 38 are located so that a three-, six-, or nine-knife cutterhead can be utilized at the option of the operator. Obviously, to switch from a nine-knife cutterhead to a three-knife cutterhead, all the knives are removed except for

every third knife. To switch from the nine-knife cutterhead to a six-knife cutterhead, it is necessary to move six of the knives and reinstall three in alternate bores 52, which are not utilized in the nine-knife cutterhead.

Each support element 44 also includes an outer body portion 60 which projects in a generally radial direction from the disk-like radial members 36 and 38, and each outer body portion 60 has a flat knife seat 62 facing in the direction of rotation outwardly of the radial member. The flat rearward surface of the inner portion 54 of the knife seats flush against the knife seats 62 of each pair of support elements, and, as previously described, the right-hand support element for each knife is mounted on the right-hand radial member 36 at a slightly different angle than the left-hand support element is mounted on the left-hand radial member 38 to compensate for the angled knife, the knife seat 62 on the right-hand element extending in a generally radial direction while the knife seat 62 on the left-hand element is only approximately radial and lies in a plane somewhat offset from the axis of the cutterhead. As is apparent from FIG. 3, the seats for both the support elements lie in the same plane, which is slightly angled relative to the cutterhead axis at the same approximately 8° angle as the knife.

Each outer body portion 60 is provided with a slot 64 which extends through the outer body portion normal to the knife seat 62, the slot 64 being elongated in a generally radial direction. Each knife is provided with a pair of bores 66 through the flat inner portion 54 of the knife opposite the knife seats 62, and a pair of bolts 68 respectively extend through the bores 66 and through the slots 64 in the respective support elements 44 for each knife. A nut 70 and washer 71 are mounted on the end of each bolt 68 in engagement with the rear side of the outer body portion 60, and cam 72 is welded to each bolt 68 immediately under the bolt head coaxially with the bolt. As is apparent, the opposite sides of the cam are flat and the rearward side of the cam seats flush against the forward side of the flat portion 54, so that the cam functions as a washer when the nut 70 is tightened to clamp the knife to the knife seats 62. As is also apparent, when the nut 70 is loosened, the bolt 68 and the knife carried thereby is shiftable in a generally radial direction along the generally radial slots 64 in the outer body portion 60 of the support element 44. The edge of the cam 72, which forms the cam surface, engages an abutment 74 on the support element 44 adjacent the inner edge of the knife, so that rotation of the bolt and the cam 72 attached thereto in one direction cams the bolt and knife outwardly in a generally radial direction, sliding the knife along the knife seat 62, after, of course, the nut 70 is loosened. A set screw 76 is mounted in a generally radial threaded bore 77, which extends through the outer body portion 60 into the slot 64, the set screw 76 being locked in place by a lock nut 78, the inner end of the set screw being engageable with the shank of the bolt 68 to prevent outward movement of the bolt and the knife carried thereby.

In operation, the set screw prevents outward shifting of the knife due to the centrifugal force on the knife, which might occur if the nut 70 is not sufficiently tightened to provide sufficient clamping force. The cam 72 engages the abutment 74 to prevent any inward movement of the knife.

When it is desired to adjust the knife to obtain proper registration with the shear bar 22, as a result of the removal or addition of knives, or the replacement of one or more knives, or when the knives are sharpened or the shear bar has been adjusted, the clamping nuts 70 for the knife to be adjusted are loosened, the screws 76 and lock nuts 78 are loosened, and the knife is adjusted by rotating the bolts 68 and the cam 72 attached thereto. This forces the knife outwardly, and when it reaches the desired position, the nuts 70 are tightened, and the set screws 76 are then tightened against the respective bolts 68 and locked in place with the locking nuts 78. During adjustment of the knives, the nuts 70 are maintained sufficiently tight to prevent slippage of the knives, although they are sufficiently loose so that the knife can be forced outwardly by means of the respective cams. As is apparent, the use of the cams to adjust the knives allows the operator to accurately control the movement of the knife, so that all the knife cutting edges can be adjusted to the same radius and each knife will maintain the proper registry with the shear bar.

I claim:

1. A reel-type cutterhead for a harvesting machine comprising: an axial shaft; a pair of radial members mounted on the shaft; a plurality of knife support elements mounted on each radial member, each support element including a seat, an abutment, and an approximately radially extending slot; a plurality of generally longitudinally extending parallel knives having cutting edges at the cutterhead periphery generating a cylinder as the cutterhead rotates, each knife being mounted on the seats of a pair of support elements respectively attached to the separate radial members; a pair of bolts respectively extending through each knife and through the slots in the respective support elements; nut means respectively threaded on the bolts to releasably clamp the knife against the support element seats; and cam means operatively associated with each bolt for shifting the bolt along its respective slot in a generally radial direction to adjust the bolt and the knife connected thereto in response to adjustment of the cam means when the nut means are loosened to unclamp the knife from the support element seats.

2. The invention defined in claim 1 and including a locking screw mounted in each support element and

engageable with the respective bolts to lock the bolts in the selected position.

3. The invention defined in claim 1 wherein the cam means are coaxially connected to and rotatable with the respective bolts.

4. The invention defined in claim 1 wherein each knife includes a flat, generally radially extending inner portion which seats against the support element seats and an inclined outer portion extending outwardly and in the direction of normal rotation from the inner portion and having said cutting edge on its leading edge.

5. A reel-type cutterhead for harvesting machine comprising: an axial shaft; a pair of radial members attached to the shaft; a plurality of knife support elements attached to each radial member at equiangular intervals, each support element having an abutment, an approximately radially extending seat, and an approximately radially extending slot; a plurality of generally parallel and longitudinally extending knives, each knife having a flat generally radially extending inner portion engaging the seats of a pair of support elements on different radial members and being radially adjustable thereon, and an outer portion inclined in the direction of cutterhead rotation with the cutting edge at the outer periphery generating a cylinder as the cutterhead rotates; a pair of bolts respectively extending through the flat inner portion of each knife and through the slots in the respective support elements; a nut threadable on each bolt for releasably clamping the knife to the associated support element; and an adjustable cam operatively associated with each bolt and engageable with the associated support element abutment to radially shift the bolt along the slot and the knife carried thereby along the support element seat in response to adjustment of the cam when the nut is loosened to unclamp the knife on the seat.

6. The invention defined in claim 5 wherein the cam is mounted on the head end of the bolt adjacent the flat inner portion of the knife and rotates with the bolt to radially adjust the bolt and the knife carried thereby in response to rotation of the bolt.

7. The invention defined in claim 6 and including a locking screw extending through each support element into the slot and engageable with the bolt to lock the bolt in the selected position.

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