Aug. 28, 1962 D. R. MARKHAM ETAL 3,050,927

ROTOR FOR AGRICULTURAL MACHINES AND THE LIKE

Filed April 27, 1960

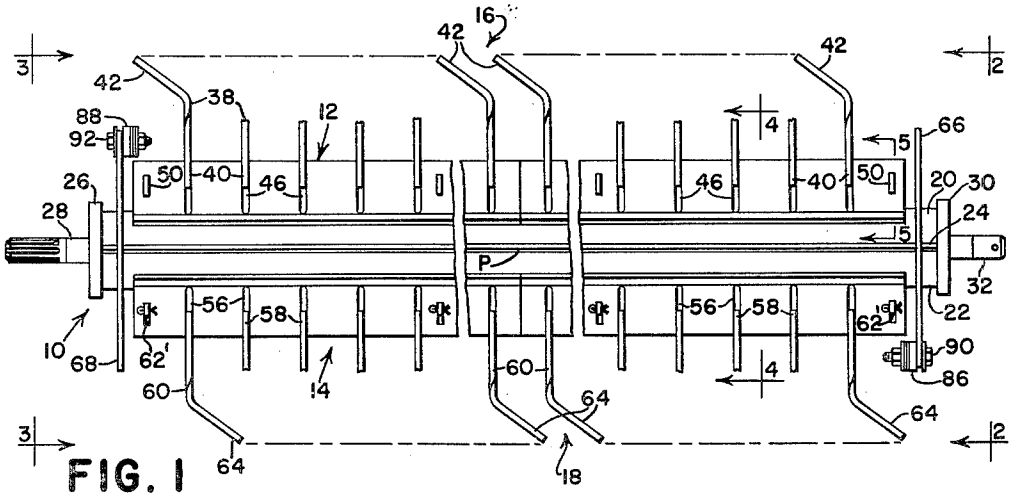


FIG. 1

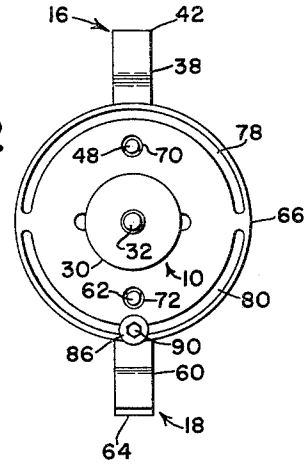


FIG. 2

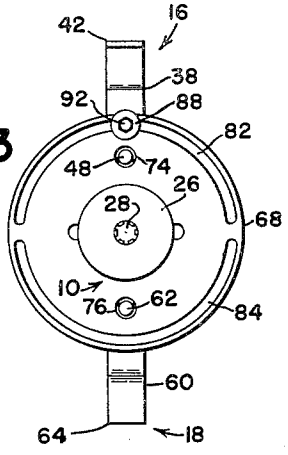


FIG. 3

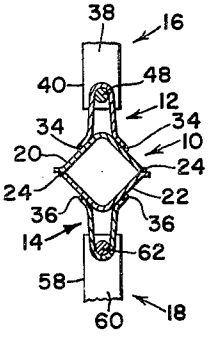


FIG. 4

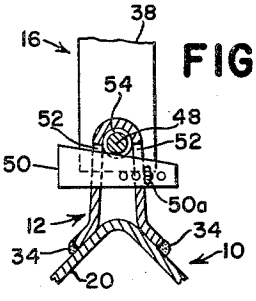


FIG. 5

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ROTOR FOR AGRICULTURAL MACHINES AND THE LIKE

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This invention relates to a rotor and more particularly to a rotor construction for use in agricultural machines and the like, such as crop-harvesting machines of the rotary chopper or rotary mower type in which the rotor operates on a transverse horizontal axis and includes a plurality of arm-like elements or flails having outer portions formed as or with cutting edges.

Rotors of this character must operate at relatively high speeds in order to function properly and the combination of high-speed rotation and general construction of the rotor imposes many limitations on the facility with which an adequate rotor may be designed and manufactured at low cost. In a typical rotor construction, the arm-like elements or flails are pivotally connected at their inner ends to the shaft means or to some mounting structure carried by the shaft means. Because of the several components, individual component weights are apt to change and the problem of unbalance becomes increasingly significant. This is especially true when the rotor is of relatively elongated design, because of the unbalanced couple or overturning moment created by centrifugal force during rotation of the rotor because of differences in weight at opposite ends of the rotor. This problem is accentuated in a rotor in which the design is such that the centers of gravity of the elements in one set of arms are axially offset in a direction opposite from the axial off-set of the centers of gravity in the other set of arms. In general, the problem just referred to must find a solution consistent with economy in manufacture.

According to the present invention, a novel and improved rotor construction has been evolved in which the foregoing disadvantages are eliminated while at the same time obtaining the benefits of an improved design at relatively low cost. It is a principal object of the invention to provide an improved rotor construction having improved mounting structure for the arms, in which respect the mounting structure features a tubular member having radial slots therein in which the inner ends of the arms are respectively received so as to be pivotally connectible to the mounting structure by an axially insertible and removable connecting rod. The rotor design permits the use of cutting portions which are axially oflset in one direction opposite to the axial offset of the cutting portions on the opposite set of arms, because of the improved use of novel balance weight means for canceling out the overturning moment referred to above. In this aspect of the invention, it is a feature to provide means for enabling adjustment of the weight means as to location relative to the associated set of arm-like elements.

The foregoing and other important objects and desirable features inherent in and encompassed by the invention will become apparent as a preferred embodiment thereof is disclosed in detail in the following description and accompanying sheet of drawings, the several figures of which are described below.

FIG. 1 is an elevation of the rotor, with intermediate portions broken away to enable the use of a larger scale in the drawing.

FIG. 2 is an end view as seen generally along the line 2—2 on FIG. 1.

FIG. 3 is an end view as seen along the line 3—3 of FIG. 1, showing the opposite end of the rotor.

FIG. 4 is a fragmentary section on the line 4—4 FIG. 1.

FIG. 5 is an enlarged fragmentary section on the line 5—5 of FIG. 1.

The rotor chosen for purposes of illustration is of the type having two sets of arm-like elements, disposed in diametrically opposed relation. However, as will be clear, the features of the invention may be employed in rotor designs having elements different in kind and number from those shown.

In the present case, the rotor comprises a central shaft means **10** carrying at diametrically opposite sides thereof first and second mounting structures **12** and **14**, the former carrying a first set **16** of arm-like elements and the latter carrying a second set **18** of similar but asymmetrically arranged arm-like elements.

As best shown in FIG. 4, the shaft means **10** may comprise a center elongated tubular section made up of first and second similar halves **20** and **22** of V-shaped or angle section, the two sections being assembled as shown to afford a tubular shaft of square section, the free edges of the halves **20** and **22** being preferably rigidly secured as by welding at **24**. Opposite ends of the square shaft section are rigidly secured as by welding respectively to first and second opposite end elements, the former comprising a disk **26** and coaxial stub shaft **28** and the latter comprising a similar disk **30** and a coaxial stub shaft **32**. The stub shaft **28** as shown may be splined to facilitate driving of the rotor.

The first mounting structure **12** is tubular and is substantially coextensive in length with the shaft means and is preferably made up of steel plate bent to inverted U shape, the legs of the U having their terminal portions flared oppositely outwardly and rigidly secured as by welding at **34** to the ridge or apex portion of the shaft section **20**. The second mounting structure **14** is similarly constructed but in the position shown in the drawings is of U shape and has its flared terminal portions welded at **36** to the apex portion of the other shaft half or section **22**. The construction as thus far described comprises a simple and economically fabricated welded assembly, which readily lends itself to mass-production methods because it may be fabricated by the use of suitable jigs, fixtures etc.

The first set **16** of arm-like elements comprises a plurality of arms **38**, each of which has an inner end **40** and an outer end **42**. The inner ends are proximate to the mounting structure **12** and this structure is provided with a plurality of radially outwardly opening, uniformly axially spaced apart radial slots **46** which respectively receive the inner ends of the arms. A mounting rod **48** is passed endwise through the tubular structure **12** and through the apertured inner ends of the arms **38**, whereby the arms are pivotally connected to the shaft means **10** via the mounting structure **12**. The rod **48** is releasably retained against endwise removal by retaining means best shown in FIG. 5 as comprising a member in the form of a wedge **50** disposed in intersecting relationship to the structure **12**, opposite legs of the structure being apertured at **52** to receive the wedge. The rod **48** in the area of the wedge **50** is provided with a recess, here in the form of an annular groove **54** which receives the wedge. The wedge is confined against axial displacement by the size of the apertures **52** and the rod **48** is confined against axial displacement because of the receipt of the wedge by its groove **54**. A removable retaining pin **50***a* passed through one of several holes in the wedge at its small end and externally of the mounting structure **12** at that side retains the wedge against displacement. Thus, there is provided an effective retaining means adequate to retain the rod **48** even during high-speed rotation of the rotor.

The second mounting structure may be similarly con-

structed and accordingly has therein a plurality of slots 56 respectively radially coplanar with the slots 46 and carrying the apertured inner ends 58 of arms 60 in the second set 18, a second mounting rod 62 being passed through the tubular structure 14 and through the apertured inner ends of these arms in a manner similar to that described above in connection with the mounting rod 48. Releasable retaining means, comprising wedges 62' at opposite ends of the structure 14, are provided. Thus, the basic structure is symmetrical at diametrically opposite sides of the axis of the shaft means.

But, in the particular design of rotor illustrated, the symmetry is not carried out completely, because the outer end portions 42 of the arms 38, which may represent cutting portions, are axially offset from the planes of the respective slots 46 toward the first end of the shaft means comprising the components 26—28, whereas the outer end portions 64 of the arms in the other set are axially offset toward the other end of the shaft means. This means that the center of gravity for each of the arms 38 in the set 16 will be axially offset to the left of the radial plane of its inner end portion 40, and this will be true of all arms in the set 16. The axial offset of the center of gravity of each arm 60 in the set 18 will be in the opposite direction. Thus, when the rotor is rotated, the centrifugal force acting on the arms will be such as to create a couple or overturning moment tending to overturn the rotor end-for-end about a point, such as the point P, intermediate the opposite ends of the rotor. Although obviously the rotor is supported at bearings at its opposite shaft ends 28 and 32, the overturning moment or couple will create undesirable vibration, and it is therefore desirable to cancel the overturning moment so that the rotor runs in balance.

For this purpose, the shaft means is provided at its opposite ends with first and second support means respectively in the form of circular plates 66 and 68. These plates are of such diameter as to diametrically overlap the support structures 12 and 14 and for this purpose the plate 66 is provided with diametrically opposed apertures 70 and 72 and the plate 68 is provided with similar apertures 74 and 76. The apertures 70 and 74 are respectively in axial register or alinement with the upper mounting rod 48, and the apertures 72 and 76 are similarly disposed relative to the axis of the other mounting rod 62. These apertures therefore permit endwise removal of the respective rods when the respective retaining means are released, thus facilitating disassembly of the arms for replacement etc. The feature is of course useful in assembling the rotor construction.

The two plates 66 and 68 may be made identical so as to avoid the necessity for providing lefts and rights, and consequently the plate 66 has upper and lower diametrically opposed arcuate solts 78 and 80 and similar slots 82 and 84 are provided in the other plates 68. However, in the case of the plate 66, only the lower slot 80 is used as support means for carrying balance weight means 86. Conversely, only the upper slot 82 in the other plate 68 is used for carrying a second balance weight means 88. It will be noted that the weight means 86 occupies the same diametrical relation as the arms 60 in the set 18 and is also at that end of the rotor toward which the outer portions 64 of the arms 60 are axially offset. The weight means 88 occupies the same relation relative to the axially offset outer end portions 42 of the arms 38.

The plates may be secured to the shaft means 10 by welding thereto; although, any suitable connection may be employed. For the purpose of calibrating the weight means, each may be made up of a plurality of separate weights, including a large weight and a plurality of small weights, which will be clear without elaboration. These may be retained by releasable securing means, such as a bolt and nut assembly 90 for the weight means 86 and a bolt and nut assembly 92 for the weight means 88.

Thus, not only may additional weights be added to either of the bolts, but the concerned weight may be adjusted angularly in its arcuate slot to achieve the necessary balance.

In actual practice, it is known from the distribution and weight characteristics of the knives in each row the extent to which the rotor is unbalanced, and the correction plates or support means 66 and 68 are located to produce a couple which is in the proper direction and location as respects the overturning couple but of a smaller magnitude. The assembly is then placed in a balancing machine and rotated and the machine is calibrated to indicate where and how much weight to add in the slots 80 and 82. This not only cancels out the aforesaid unbalance but also cancels out any unbalance resulting from variations in manufacturing tolerances.

The overall result of the rotor is a rotor construction that is capable of high-speed operation and that will run smoothly and in relatively perfect balance. The assembly details are such as to lend themselves to low-cost mass-production methods. At the same time, the mounting rods may be readily removed to permit replacement of the arms as the arms wear during use.

Features and advantages other than those enumerated herein will readily occur to those versed in the art, as will many modifications and alterations in the preferred embodiment of the invention disclosed, all of which may be achieved without departure from the spirit and scope of the invention.

What is claimed is:

1. A rotor of the class described, comprising: elongated shaft means having first and second opposite ends; first and second generally radial arm-like elements disposed respectively at diametrically opposite sides of the shaft means, the elements in each set respectively having inner ends spaced uniformly axially apart and connected to the shaft means so that the inner end of each element in one set lies in generally the same radial plane as the diametrically opposite element in the other set, the elements in the first set respectively having outer ends axially offset from their respective inner ends toward the first end of the shaft means and the elements in the second set respectively having outer ends axially offset toward the second end of the shaft means whereby centrifugal force during rotation of the rotor produces an end-for-end overturning moment about a point intermediate the ends of the shaft means; first and second balance weight support means carried by the shaft means respectively at its first and second ends and respectively diametrically opposed according to the diametrically opposed relation of the first and second sets of elements; and first and second balance weight means carried respectively by the support means for canceling the aforesaid overturning moment during rotation of the rotor.

2. The invention defined in claim 1, in which: each support means includes a part having therein an arcuate slot formed about the shaft means axis, and each weight means is carried in the associated slot for selective angular adjustment.

3. A rotor of the class described, comprising: elongated shaft means having first and second opposite ends; first and second generally radial arm-like means disposed respectively at diametrically opposite sides of the shaft means, each arm-like means having an inner portion connected to the shaft means and said inner portions lying in generally the same radial plane and the first arm-like means having an outer portion offset axially from said plane toward the first end of the shaft means and the second arm-like means having an outer portion axially offset from said plane toward the second end of the shaft means whereby centrifugal force during rotation of the rotor produces an end-for-end overturning moment about a point intermediate the ends of the shaft means, first and second balance weight support means carried by the shaft means respectively at its first and second ends and re-

spectively diametrically opposed according to the diametrically opposed relation of the first and second arm-like means; and first and second balance weight means carried respectively by the support means for canceling the aforesaid overturning moment during rotation of the motor.

4. A rotor of the class described, comprising: elongated shaft means having first and second opposite ends; first and second generally radial arm-like means connected to the shaft means in diametrically opposed relation and so constructed that their centers of gravity are axially offset relative to each other respectively toward the first and second ends of the shaft means whereby centrifugal force during rotation of the rotor produces an end-for-end overturning moment about a point intermediate the ends of the shaft means; and first and second balance weight means carried respectively by the first and second ends of the shaft means for canceling the aforesaid overturning moment during rotation of the rotor.

5. The invention defined in claim 4, in which: each weight means is selectively angularly adjustable about the shaft means axis.

6. A rotor of the class described, comprising: elongated rotatable shaft means having first and second opposite ends; first and second tubular mounting structures connected to and paralleling the shaft means in diametrically opposed relation and substantially coextensive in length with said shaft means, each structure having therein a plurality of uniformly axially spaced, radially outwardly opening radial slots, the slots in one structure being respectively radially coplanar with those in the other structure; first and second sets of arm-like elements carried respectively by the first and second structures, each arm having an inner apertured end received by a slot so that the inner ends of the arms in each set are alined on an axis within the associated structure; first and second rods substantially coextensive in length with and received respectively within the structures and through the apertured ends of the associated arms; first and second retaining means releasably securing the rods against endwise removal; first and second plates secured respectively to the first and second ends of the shaft means in diametrically overlapping relation to the mounting structures, each plate having an opening therein in axial register with a mounting rod so as to enable endwise removal and insertion of the rod; each element in the first set having an outer end offset axially from its inner end toward the first plate and each element in the second set having an outer end axially offset from its inner end toward the second set whereby centrifugal force during rotation of the rotor produces and end-for-end overturning moment in the rotor about a point intermediate the ends thereof; and first and second weight means carried respectively by the plates for canceling said overturning moment during rotation of the rotor.

7. A rotor of the class described, comprising: elongated rotatable shaft means; first and second tubular mounting structures connected to and paralleling the shaft means in diametrically opposed relation and substantially coextensive in length with said shaft means, each structure having a radially outermost wall of U-shaped section providing a relatively circumferentially narrow pocket having its lengthwise axis eccentric to and paralleling the axis of the shaft means, each pocket opening axially toward at least one end of the rotor, and each wall having therein a plurality of uniformly axially spaced, radially outwardly opening radial slots, the slots in one structure being respectively radially coplanar with those in the other structure; first and second sets of arm-like elements carried respectively by the first and second structures, each element having an inner end provided with an aperture and received by a slot, said apertures in each set being alined on the axis of the pocket of the associated structure; first and second rods substantially coextensive in length with and received respectively endwise through the open ends of the pockets and coaxially through the

apertured ends of the associated elements, each rod being of such diameter as to relatively closely fit its pocket so as to minimize looseness thereof in its pocket; and first and second retaining means releasably securing the rods against radial inward displacement and also against endwise removal from the respective pockets.

8. A rotor of the class described, comprising: elongated rotatable shaft means; first and second tubular mounting structures connected to and paralleling the shaft means in diametrically opposed relation and substantially coextensive in length with said shaft means, each structure having a radially outermost wall of U-shaped section providing a relatively circumferentially narrow pocket having its lengthwise axis eccentric to and paralleling the axis of the shaft means, each pocket opening axially toward at least one end of the rotor, and each wall having therein a plurality of axially spaced, radially outwardly opening radial slots; first and second sets of arm-like elements carried respectively by the first and second structures, each element having an inner end provided with an aperture and received by a slot, said apertures in each set being alined on the axis of the pocket of the associated structure; first and second rods substantially coextensive in length with and received respectively endwise through the open ends of the pockets and coaxially through the apertured ends of the associated elements, each rod being of such diameter as to relatively closely fit its pocket so as to minimize looseness thereof in its pocket; and first and second retaining means releasably securing the rods against radial inward displacement and also against endwise removal from the respective pockets.

9. A rotor of the class described, comprising: elongated rotatable shaft means; a plurality of tubular mounting structures connected to and paralleling the shaft means in angularly spaced relation about and running lengthwise of said shaft means, each structure having a radially outermost wall of U-shaped section providing a relatively circumferentially narrow pocket having its lengthwise axis eccentric to and paralleling the axis of the shaft means, each pocket opening axially toward at least one end of the rotor, and each wall having therein a plurality of axially spaced, radially outwardly opening radial slots; a plurality of sets of arm-like elements carried respectively by the mounting structures, each element having an inner end provided with an aperture and received by a slot, said apertures in each set being alined on the axis of the pocket of the associated structure; a plurality of rods, one for each structure, received respectively endwise through the open ends of the pockets and coaxially through the apertured ends of the associated elements, each rod being of such diameter as to relatively closely fit its pocket so as to minimize looseness thereof in its pocket; and retaining means releasably securing the rods against endwise removal from the respective pockets.

10. The invention defined in claim 9, in which: each retaining means includes a member transverse to its rod and structure, said rod having a member-receiving recess therein and said structure being transversely apertured to receive the member.

11. The invention defined in claim 10, in which: the member is a wedge effecting a wedging lock between the rod and member, and means is provided to releasably hold the wedge in place.

12. The invention defined in claim 9, in which: each mounting structure is of U-shaped section, having its bight radially outwardly and its legs radially inwardly toward and secured to the shaft means, said bight and a portion of each leg being slotted to provide said slots.

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