A shredder-bagger for disposing of garden debris in which a blade assembly rotates in a shallow cylindrical chamber, the blade assembly comprising a plurality of overlapping slightly offset blades cooperating with breakers and with the lowermost blade arranged close to the bottom wall and fully extended to the side wall for maintaining the adjacent surfaces constantly swept free of debris. The bodies of the blades are clamped together as a unit in spaced relation telescoped over a hub and with a friction clutch interposed between the lowermost blade and the hub. The clutch includes a Belleville washer and rubber washer acting in cooperation with one another to apply axial clutching force.

6 Claims, 5 Drawing Figures
SHREDDER-BAGGER HAVING BLADE ASSEMBLY

It is an object of the present invention to provide a blade assembly which is highly efficient and which is capable of handling debris at a greater rate, as well as handling a wider variety of debris, than conventional shredder-baggers, ranging all the way from dry, fluffy material such as dried leaves to heavy wet materials, green branches and the like.

It is a related object to provide a shredder-bagger which operates smoothly and without vibration, which is capable of efficiently utilizing engines of high horsepower even in a machine of compact dimensions, which is substantially jam proof and which may be operated at full capacity without care, maintenance or adjustment for long periods of time. In this connection it is an object to provide a blade assembly which has improved friction clutching arrangement to protect both blades and engine against shock.

It is a further detailed object to provide a shredder-bagger which is continuously self-cleaning and which avoids build-up of a caking type deposit within the machine, as occurs in more conventional machines, particularly where the machine is used for disposing of waste of a succulent nature.

It is, in addition, an object to provide a blade assembly for a shredder-bagger which, notwithstanding its capabilities, is highly economical in material and construction.

Other objects and advantages of the invention will be apparent upon reading the attached detailed description and upon reference to the drawings in which:

FIG. 1 is a general perspective view of a shredder-bagger employing the present invention.

FIG. 2 is a horizontal section taken through the machine along the line 2—2 in FIG. 3.

FIG. 3 is a vertical section taken along the line 3—3 in FIG. 2, developed, and with portions broken away.

FIG. 4 is an enlarged fragmentary elevation showing the hub.

FIG. 5 is an exploded view of the hub assembly of FIG. 4.

While the invention has been described in connection with a preferred embodiment, it will be understood that I do not intend to be limited to the particular embodiment shown but intend, on the contrary, to cover the various alternative and equivalent constructions included within the spirit and scope of the appended claims.

Turning now to FIG. 1 there is shown a shredder-bagger 10 having a frame 11 supported, with respect to the ground, upon wheels 12. Superimposed upon the frame is an engine 13 and adjacent the engine is a hopper 14. Garden debris which is fed into the hopper is forcibly ejected in an air stream via a discharge chute 15 into a suitable receiving bag.

Turning next to FIGS. 2 and 3 it will be seen that the frame defines a shallow cylindrical chamber 20 having a top wall 21, a flat bottom wall 22 and a circular side wall 23. The top wall and side wall are preferably integral with one another and the bottom wall, which provides access, is held in place by clips 24. The engine shaft, indicated at 25, extends axially downward into the chamber. Material is fed from the hopper into the chamber via a receptacle 26.

In accordance with the present invention a blade assembly is provided in the shredding chamber mounted upon a hub which is keyed to the shaft and made up of a plurality of blades which are telescoped over the hub and coupled to it via a friction clutch, the blades being offset slightly but with their bodies overlapping one another and clamped together with spacers to form a rigid box-like assembly. Thus the blade assembly, indicated at 30, has, in the present instance, a top blade 31 which is in leading position, a middle blade 32 and a bottom blade 33. The blades have respective central openings 34, 35, 36 of the same diameter and sharpened tips 37, 38, 39 which are, as shown, retracingly angled, or chamfered. The blades are telescoped over, and permanently captive upon, the hub 40 which is keyed, by a key 41, to the motor shaft 25. The hub is held upon the motor shaft by an axial screw 42 and end washer 43. Forming a part of the hub is a flange 44 having an adjacent thread 45, the hub being flattened in the region of the thread as indicated at 46.

For the purpose of securely clamping all of the blades together in the slightly offset relation, a pair of clamping bolts 50 are used, having nuts 51 and spacers 52, and with the bolts extending through the entire stack of blades. In addition, the top blade is connected to the middle blade by a pair of bolts 53 with nuts 54 and spacers 55. Finally, the middle blade is connected to the lower blade by bolts 56 having respective nuts 57 and spacers 58. The combination of the overlapping blades, plus the bolts and spacers clamping the blade bodies together, produces a box-like structure in which each blade reinforces the others to increase its effective strength in the shredding operation and in which each blade, moreover, acts to prevent flexure and vibration of the neighboring blades.

For the purpose of conveying driving torque from the hub to the blade assembly, a clutch assembly frictionally couples the lowermost blade to the flange 44 on the hub. The clutch assembly, indicated at 60, includes first and second friction washers 61, 62 which straddle the blade 33, a rubber washer 63, a Bellville type washer 64 and a lock washer 65, all of which are sandwiched tightly together against the hub flange by means of a nut 66. The washers 62, 65 are preferably formed with a "flatted" internal opening which registers with the flat 46 on the hub.

In accordance with one of the specific aspects of the present invention the rubber washer faces the concave side of the Bellville washer, with the result that the two act cooperatively in the resilient transmission of axial force from the nut to the clutching surfaces. Because of the concave nature of the Bellville washer the rubber washer is held captive at its periphery so that it is largely confined and prevented from spreading radially in the face of the axial force. At the same time the volumetric confinement of the rubber washer produces a reaction force having an increasing spring rate so that the rubber washer serves to prevent collapse of the Bellville washer, particularly where the latter is severely or overly tightened. As is well known, a Bellville washer is a convenient means for securing resiliency in a compressed stack, but where a Bellville washer is stressed beyond the point of yield it tends to collapse, that is, revert to a flat, non-resilient state. For this reason Bellville washers have largely been avoided in assemblies of this kind, particularly assemblies where the adjustment is at the mercy of a householder who may
lack mechanical knowledge and skill. By contrast it is found that, using the rubber washer and Bellville washer in combination, the possibility of overstressing the Bellville washer by excessive tightening is largely precluded. In normal operation, and with the nut properly tightened, the Bellville washer and rubber washer, acting together develop an optimum axial clutching force with adequate and automatic take-up of any wear which might occur at the clutch faces. It is found that the present blade assembly may be left in place, without maintenance, or adjustment, almost indefinitely. Shredding largely occurs by reason of impact and it is not therefore necessary to periodically sharpen the blades, as it is in the case of a rotary mower, so that the permanence of the adjustment of clutch torque is a matter of some importance.

In carrying out the invention stationary breakers are provided on the side wall of the shredding chamber having teeth which are interdigitated with the tips of the blades, the breakers being offset upwardly from the bottom wall of the chamber and the lowermost one of the blades being extended radially beyond the companion blades into close proximity to the side wall and into close running engagement with the bottom wall. Thus as shown in Figs. 2 and 3, a total of three breakers are used indicated at 70, 71 and 72, held in position by mounting screws 73 and having a total of three teeth 74, 75, 76. Each breaker is mounted so that a shallow clearance space "d" exists under the lowermost tooth 76, a space which is occupied by the tips of the blade 33, which tips are radially extended in length by a distance "r" as compared to the tips of the other two blades. As a result of the close proximity of the blade 33 to the bottom wall and side wall, such walls are continuously swept clear of any debris of a type which would, in a conventional shredder, result in formation of a permanent hard cake of collected material, a cake which would have to be periodically cleaned out in order to maintain shredder efficiency. It is found that in the present construction the regions where a cake would normally collect are, instead, kept bright and clean, even where the shredder is used to dispose of succulent materials such as freshly cut weeds and foliage.

It is one of the still further features of the present invention that means are provided for protecting the seal which is present in engines at the point of entry of the shaft 25 into the engine housing. This is accomplished by providing, at the top of the blade assembly, a seal protecting disc 80 which is secured in place by the bolts 50. This disc 80 is, as shown in Fig. 3, of slightly dished construction, and fills a circular opening 81 in the top 21 of the shredding chamber. Rotation of the disc 80 at blade speed, by reason of centrifugal force, keeps the region of the shaft and its seal clear of debris of all kinds and particularly clear of the abrasive debris which would, in time, affect the integrity of the seal and which might cause a catastrophic loss of oil and failure of the engine.

It is found, in use, that the blade assembly not only has a greater volumetric efficiency, or "through put," in the handling of debris but that it has the ability to operate efficiently over a wide range of engine horsepower, being uniquely suited to making full use of the horsepower available in the larger sizes of engines, but using a frame which is not substantially greater in size than the frames which have been customarily employed with engines of more limited horsepower. Because of the limited offset between the blades the "blade rate," that is, the rate of passage of the blade cluster, is sufficiently low as to provide a well defined "insertion gap" during which a branch, for example, may be inserted a distance sufficient for acting upon, in quick succession, by the blades as a group, beginning with the top blade which is in leading position. This is to be contrasted with the progressive and relatively slower "nibbling" action which occurs when evenly angled blades are employed. Because the blades are integrated in a rigid box-like assembly, each blade assists, and is assisted by, all of the others in resisting bending and other forces, resulting in a structure which is strong and vibration free but in which each blade may be made of stock of relatively limited thickness resulting in a low total weight and hence sharply reduced material costs as compared to conventional multi-blade structures. Assembly is quick and easy since the bolts and spacers assure accurate spacing, parallelism, and phasing. Alignment with the breaker openings is thus assured. The blade assembly, while intended for use in a "top of line" machine is sufficiently economical as to permit its advantages to be utilized even in machines of more limited horsepower intended for sale in the "economy" market.

Because the blades, taken together, form a wide and well-defined "front," leaves and similar light debris are moved at a high and efficient rate, with relative advancement of the top blade producing a suctional effect. Also because of the offset between the blades and their mutual rigidification, it is found that a machine using the present blade assembly is capable of disposing of branches which are thicker than those which can be handled by more conventional machines. However, in the event that an obstruction is interposed which is heavy enough to resist the action of the blades, the improved clutching system serves to protect both blades and engine against development of destructive torque, while the clamping structure positively maintains the relative phase positions.

While the term "rubber" has been used for convenience in describing the washer 63, it will be understood that this term is intended, in a generic sense, to include artificial rubber and similar resilient materials commonly employed as rubber substitutes.

What is claimed is:

1. In a shredder-bagger for shredding garden debris, the combination comprising a frame defining a shredding chamber of flat cylindrical construction having a top wall, flat bottom wall and circular side wall, means defining a receptacle in the top wall and a discharge chute in the side wall, an engine having a shaft extending axially into the shredding chamber, a blade assembly secured to the shaft, said blade assembly having a hub keyed to the shaft and having a plurality of blades telescoped over the hub, means for clamping the blades together in stacked and spaced relation for rotation as a unit independently of the hub, breakers spaced about the side wall having teeth interdigitated with the tips of the blades, a friction clutch interposed between the lowermost blade and the hub for driving the blades, the blades being offset with respect to one another for acting progressively upon debris introduced into the receptacle, the degree of offset being sufficiently small so that the bodies of blades are largely overlapping the clamping means including spacers interposed between
the overlapped bodies of the blades of that the blades together form a rigid box-like assembly.

2. The combination as set forth in claim 1 in which the breakers are offset upwardly from the bottom wall with the lowermost one of the blades running in close proximity with the bottom wall and being extended radially outwardly beyond the adjacent blade and into close proximity to the side wall so that the surfaces adjacent the lower blade are constantly swept free of debris.

3. The combination as set forth in claim 2 in which the top wall has a circular opening concentric with the engine shaft and in which the blade assembly includes a superimposed seal-protecting disc rotatable therewith and filling the opening.

4. In a shredder-bagger for shredding garden debris, the combination comprising a frame defining a shredding chamber of flat cylindrical construction having a top wall, flat bottom wall and circular side wall, means defining a receptacle in the top wall and a discharge chute in the side wall, an engine having a shaft extending axially into the shredding chamber, a blade assembly secured to the shaft, said blade assembly having a hub keyed to the shaft and having a plurality of blades telescoped over the hub, means for clamping the blades together in stacked and spaced relation for rotation as a unit, the lower blade being spaced in close running engagement with the bottom wall, breakers spaced about the side wall having teeth interdigitated with the tips of the blades, coupling means interposed between at least one of the blades and the hub for driving the blades, the blades being offset with respect to one another for acting together upon debris introduced into the receptacle, the degree of offset being sufficiently small so that the bodies of blades are largely overlapping the clamping means including spacers interposed between the overlapped bodies of the blades so that the blades together form a rigid box-like assembly.

5. The combination as claimed in claim 4 in which the tips of the blades are rearangingly angled, and with the topmost blade in leading position.

6. The combination as claimed in claim 4 in which the hub has a radial flange and an adjacent external thread, one of the blades lying adjacent the flange, a nut engaging the thread, and a washer assembly interposed between the nut and the blade, the washer assembly including a rubber washer and an adjacent Bellville washer having its concave side faced toward the rubber washer so as to confine the rubber washer against radial expansion as the nut is tightened, thereby to provide clutching force, the reaction of the confined rubber washer providing a sharply rising spring rate as the nut is tightened thereby to prevent collapse of the Bellville washer upon overtightening of the nut.

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