United States Patent

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[54] **REFUSE-REDUCING MACHINE**
19 Claims, 3 Drawing Figs.

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[51] Int. Cl. B02c 13/10
[50] Field of Search ..... 241/101 M, 155, 144, 146, 157, 158, 160, 161, 162, 163, 167, 221, 222, 224, 245, 247, 248, 251, 255, 261, DIG. 23

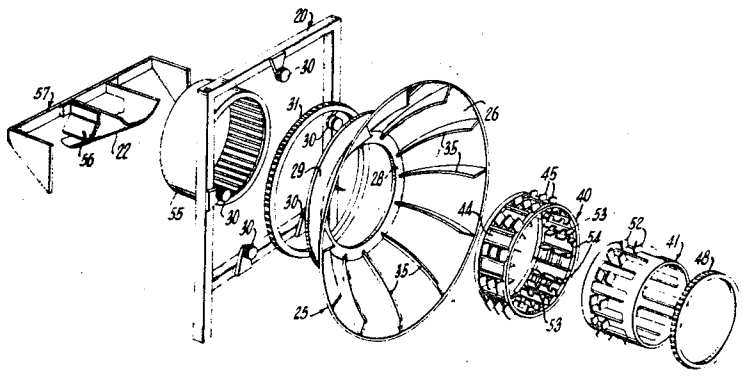
[56] **References Cited**

UNITED STATES PATENTS

370,880	10/1887	Mathiason	241/261 X
1,948,328	2/1934	Boughton	241/222 X
2,502,022	3/1950	Paul	241/261 X
3,173,619	3/1965	Bryan	241/153

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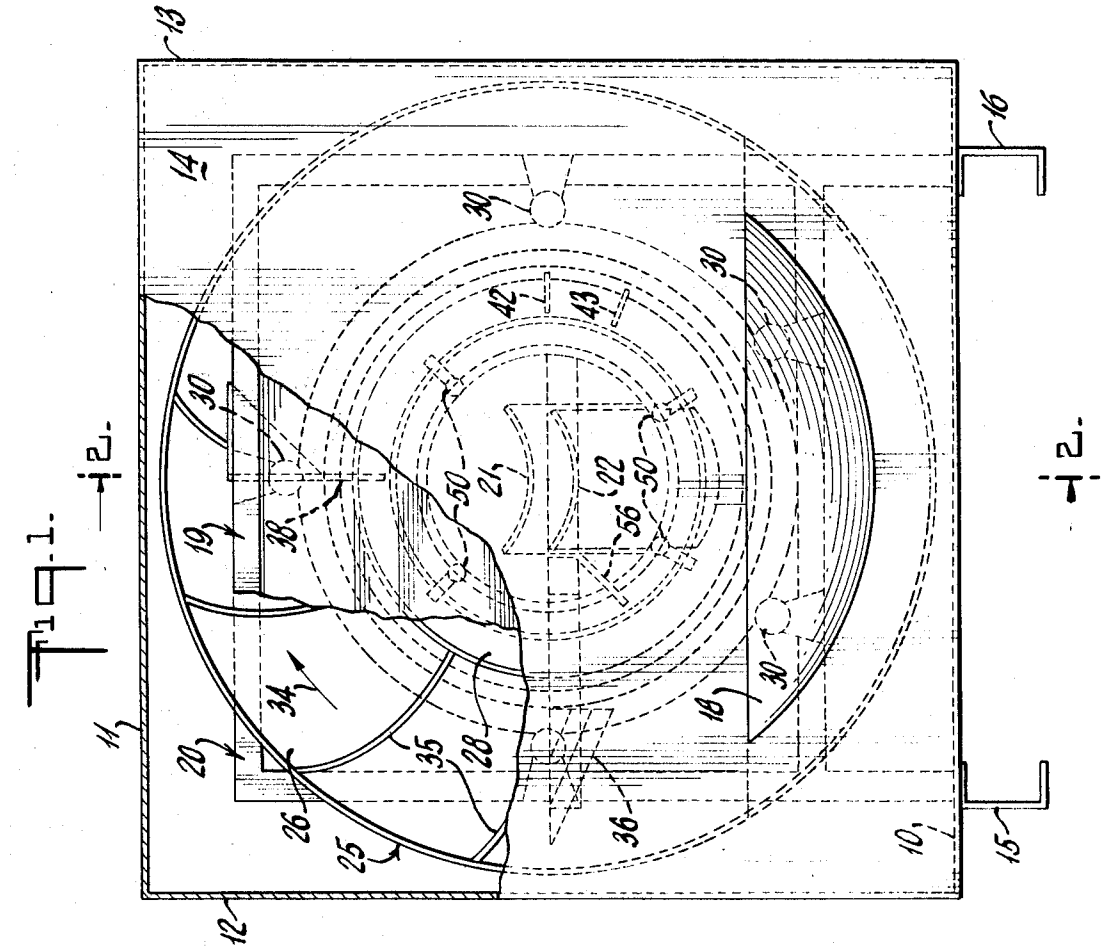
ABSTRACT: The invention contemplates refuse-reducing mechanism employing relatively rotating coaxial structures to achieve a succession of stages of progressive size reduction, as refuse is conveyed through or shredded in the mechanism. At one general axial span, plural reduction stages proceed radially inwardly, from a load in zone at maximum diameter. After such reduction, the reduced material may be axially transposed to a second general axial span for further reduction, again with radially inward progression. Thus reduced, the material may be delivered for storage or for still further reduction or other processing, as desired. The entire multistage reducer is conveniently built into a vehicle body or trailer, or it may be used in stationary applications, as for apartment houses, hospitals, grocery stores and the like.

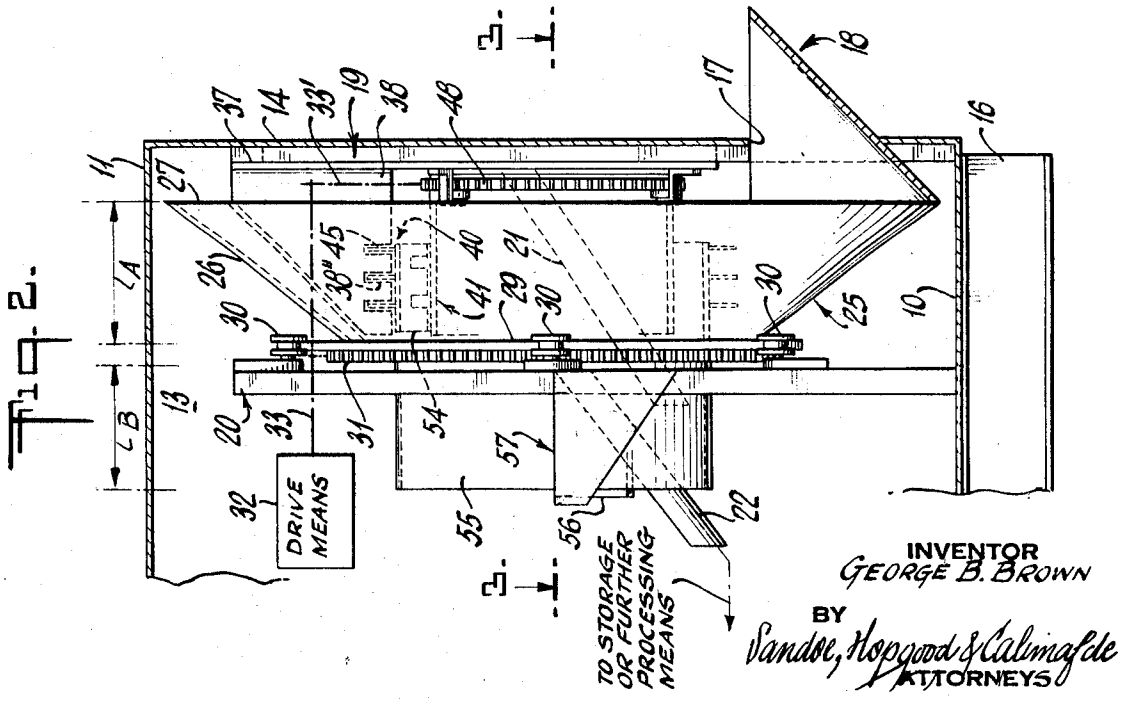


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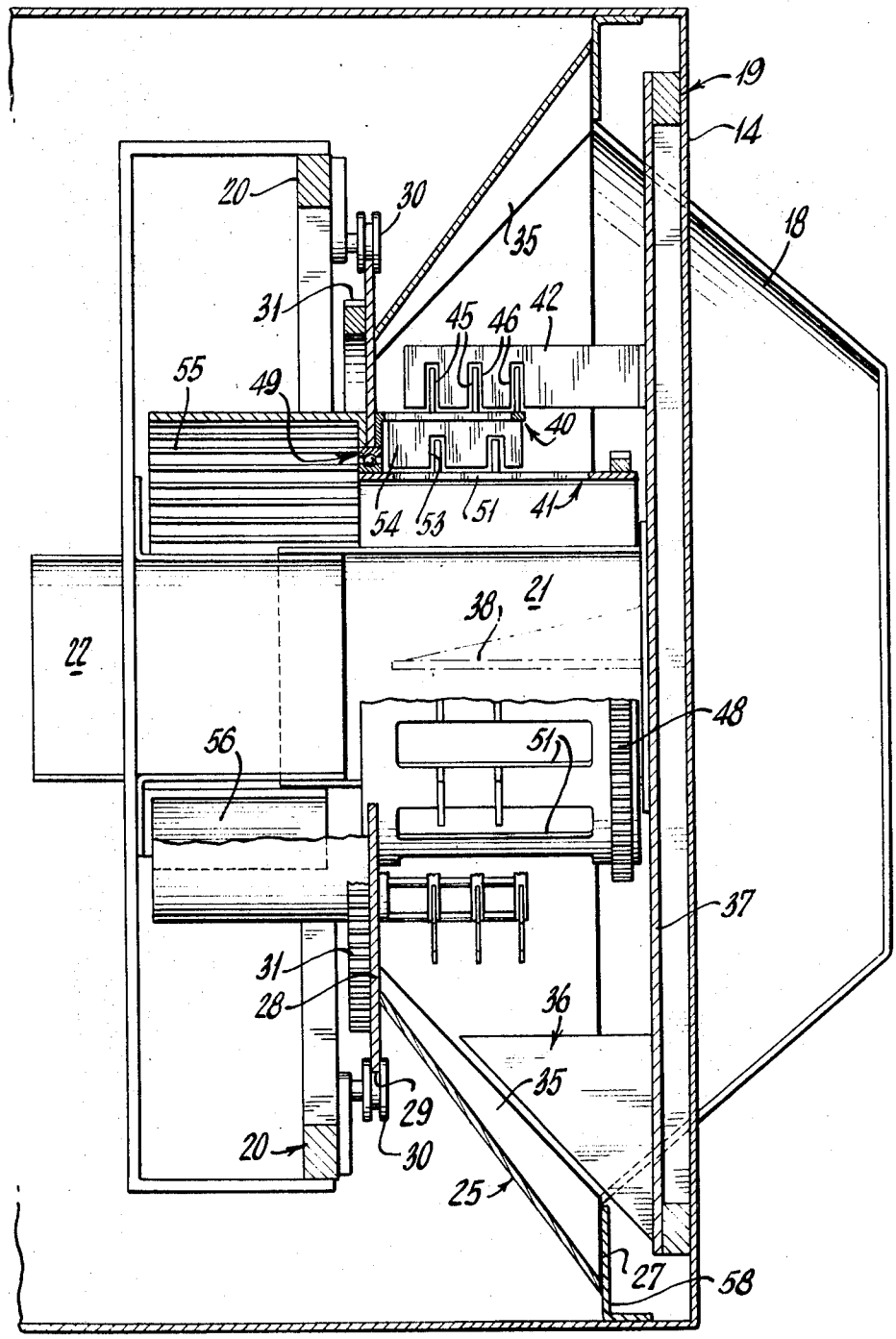




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Fig. 3.



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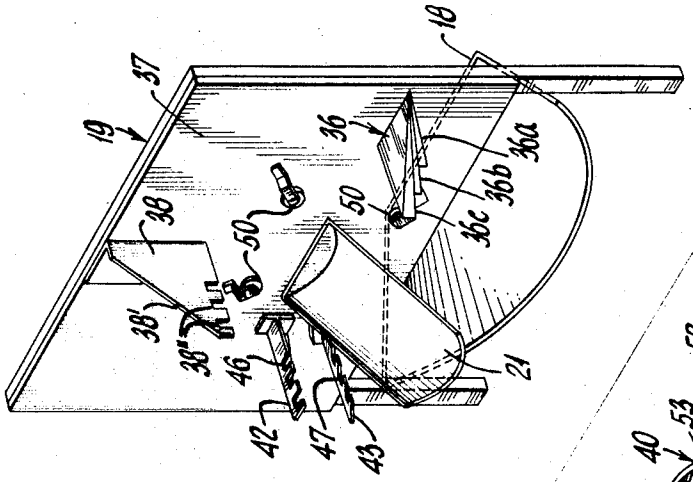


FIG. 5.

FIG. 4.

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REFUSE-REDUCING MACHINE

This invention relates to a machine for processing solid waste, such as garbage and trash, and mechanically reducing the same to a particle size which permits relatively dense storage, or more ready further compacting to still greater density.

In the collection of garbage, trash and the like refuse, the need for compaction has long been recognized. For example, some refuse-collection trucks contain devices in the form of blades to scoop up refuse which has been placed in a trough in the rear of the truck and to compact the material against a movable wall. When the truck is fully loaded, the blade becomes inoperable, the moving wall is back as far as it can go, and the truck must be emptied. The problem with such devices is that compaction is highly inefficient, since a fully loaded truck of the character indicated is still carrying more enclosed airspace than volume of solid material; compaction may be only in the order of 2:1, or 3:1 at best.

There are stationary devices, such as hammermills, in use today, particularly in apartment houses and hospitals, for effecting volume reduction by as much as 15:1, but such devices do not lend themselves directly to refuse truck use (a) because the variety of input material is relatively restricted (i.e., predictable) in the stationary applications as compared to the truck applications, and (b) the operating noise can be well contained in a building but may be a public nuisance on a truck. For example, the household waste that must be handled by refuse trucks includes pieces of wood, scrap metal, and old furniture, and the like, which is not presented for digestion by the stationary compactors and which may if necessary be culled out for other disposal; a refuse truck operator has relatively little provision for selective culling of refuse.

It is, accordingly, an object of the invention to provide an improved refuse-reducing mechanism.

Another object is to meet the above object with a mechanism inherently capable of accepting and reducing a wide variety of waste-product material.

A specific object is to achieve the above objects with structure that may be adapted to or incorporated in refuse-collection vehicles and which can attain a greater density of compacted material.

Another specific object is to achieve the above objects with a device which will more finely divide and store household-collected refuse.

A further specific object is to provide improved refuse-reducing mechanism, which is directly applicable to a refuse-collection vehicle, which will not generate excessive noise, and which will enable a truck of given volumetric storage capacity to make fewer round trips to the dump in a given day's use.

Still another specific object is to provide improved refuse-reducing mechanism for a vehicle so as to reduce the problem of waste disposal at a dump or other receiving point.

A general object is to achieve the foregoing objects with relatively simple and inexpensive mechanism, enabling volume reduction in the range of 5:1 to 10:1, and lending itself to relatively simple maintenance.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a ready of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, a preferred form of the invention:

FIG. 1 is a simplified view in end elevation showing a refuse-reducing mechanism of the invention, a portion of the near wall being broken away to reveal internal structure;

FIG. 2 is a side elevation of the reducing mechanism of FIG. 1, as seen when the housing wall is cut and sectioned at the central alignment 2—2 of FIG. 1;

FIG. 3 is an enlarged view similar to FIG. 2 but with the housing wall cut at 3—3 of FIG. 2;

FIG. 4 is a simplified exploded view in perspective, showing the several parts of the mechanism of FIGS. 1 to 3; and

FIG. 5 is a simplified perspective view of certain parts carried by a frame member of the mechanism.

Briefly stated, the invention contemplates refuse-reducing mechanism employing relatively rotating coaxial structures to achieve a succession of stages of progressive size reduction, as refuse is conveyed through or shredded in the mechanism. At one general axial span, plural reduction stages proceed radially inwardly, from a load-in zone at maximum diameter. After such reduction, the reduced material may be axially transposed to a second general axial span for further reduction, again with radially inward progression. Thus reduced, the material may be delivered for storage or for still further reduction or other processing, as desired. The entire multistage reducer is conveniently built into a vehicle body or trailer, or it may be used in stationary applications, as for apartment houses, hospitals, grocery stores and the like.

Referring to the drawings, the invention is shown embodied in a frame structure or housing, shown to include a base or floor **10**, a top **11**, upstanding sidewalls **12–13**, and a backwall **14**. The entire housing may be installed on stationary footings or on vehicular frame members; the spaced elongated girders **15–16** will be understood to designate a vehicular chassis, as in the case of a trailer, or the back end of a refuse-collection truck. The backwall **14** incorporates provision for rear loading of refuse material at a convenient relatively low elevation opening **17**, and a hopper or chute **18** is shown secured to and carried by the wall **14** at this opening, to facilitate in feed to the reducing mechanism of the invention.

Within the housing, the reducing mechanism relies upon two axially spaced frames **19–20** defining an axial span A within which plural stages of refuse reduction are accomplished. The frame **19** may be a reinforcing part of the rear wall **14**, and the frame **20** may be separately supported on the base **10** and otherwise referenced to the frame **19**, by means not shown. The product of reduction in the radial stages between frames **19–20** is collected by means such as a chute **21** for offsetting removal, to a second axial span B on the other side of frame **20**, where further reduction may proceed, prior to collection and discharge at **22** to storage or further processing means, suggested by legend in FIG. **2**.

As generally indicated, refuse-reduction proceeds radially inwardly, in a succession of stages within the span or zone A. This is accomplished using relatively rotating drum, breaker, and grid structures and may be realized about a single axis, common to and serving refuse-reduction in both the A and B zones.

In the A zone, a first drum **25** has a closed outer surface or wall **26**, extending between a relatively open end **27** (adjacent the hopper **18**) and a relatively closed end **28**. Drum **25** is shown as frustoconical, with means for rotary support and drive at the region of the frame location **20**; the rotary axis is generally horizontal, meaning that it may be within a range of elevation from horizontal, extending as much as substantially 30°, in which case of course the end **28** is the lowered end. Conveniently, the reduced or substantially closed end **28** is extended by a circular annulus **29** and is the means of rotary support of the drum, at angularly spaced grooved rollers **30** which are carried on the frame **20**. Adjacent the annulus **29**, a ring gear **31** receives rotary drive from suitable means **32**, which in the case of a truck may be a power takeoff from the propulsion engine, or which in the case of a trailer installation may be an auxiliary power source. The phantom line **33** in FIG. **2** will be understood to designate shafting to a pinion for edge drive of the drum **25**, at gear **31**. The direction of drive is indicated at **34** in FIG. **1**.

At angularly spaced locations within the drum **25**, the inner surface of its wall **26** is formed with or carries radially inwardly projecting refuse-engaging means such as lugs, blades or paddles **35**. Blades **35** are shown extending axially from end to end of the drum **25** and to be slightly bowed or spiralled, as most clearly seen in FIG. **1**. The concavity of such bowing faces upwardly, as drum **25** rotates clockwise in the sense of FIG. **1**, to engage refuse dumped in the hopper **18**, and to elevate the same to a raised or upper position. On this initial

course of refuse movement, a first stage of size reduction takes place, should the bulk of refuse be too great. This first stage is determined by the relatively great clearance between a fixed projection or breaker **36** and the path of upward movement of successive blades **35**. In the form shown (FIG. 5), breaker **36** is a rigid bracket, fixed to the front plate **37** of the rear frame **19** and having three angularly and radially outwardly projecting ribs **36***a*–**36***b*–**36***c* which, in the direction of adjacent blade movement, present progressively narrowing clearances with the path of movement of blades **35**; alternatively, separate and more greatly spaced brackets may define the successively convergent barriers of the breaker means **36**.

Thus, a bulky article of refuse, such as a wooden orange crate, will be carried upward by one of the blades **35**, to the point of crate interference with the first (**36***a*) of the breaker projections. Drum rotation will destroy the crate, to the point where some fragments may carry past the breaker means **36** while other fragments drop, only to be picked up by a succeeding blade **35**. On the next attempted pass, such other fragment may clear breaker means **36** or it may encounter destructive interference with another (**36***b* or **36***c*) of the breaker projections. Eventually, however, and in rather short order, the sufficiently fragmented parts of the whole orange crate will have cleared the first stage, at breaker **36**.

When the sufficiently broken fragments reach a sufficient elevation, they fall by gravity for the next stage of reduction, and a fixed scavenging blade or barrier **38** (also carried by the back-frame plate **37**, but at the top of the sweep of drum **25**) has a culling edge **38'** in close clearance with the path of blade movement, to pick off and drop refuse fragments which may not yet have dropped and which project radially inwardly out of this path.

The speed of rotation of drum **25** will, of course, be understood to be relatively slow, such as 5 to 10 r.p.m. for a drum of 6 to 8 ft. diameter, being the result of substantial gear reduction at the pinion drive to gear **31**. Thus, centrifugal effects are inconsequential and do not interfere with the described gravitational release of products of the first reduction stage (**36**).

As generally indicated above, the next stage or stages of size reduction proceed radially inwardly and are operative on the released products of the first reduction stage (**36**). Such further reduction may utilize relatively rotating tearing, shredding or grinding elements, and in the form shown two drums or grids **40**—**41** and fixed breakers or barriers **42**–**43** perform the function, to the point where the further reduced products of such second reduction stage fall gravitationally on the chute **21**.

The drum or grid **40** is shown to be generally cylindrical, being secured to and carried by the substantially closed wall **28** of drum **25**. It has plural elongated slots **44** spaced about its wall, to allow for radially inward passage of sufficiently small fragments, and between slots **44** spaced radially extending sets of breaker elements **45** are mounted, as three axially spaced sets which clear but radially overlap and mesh with corresponding radial slots **46**—**47** in the two fixed breakers **42**–**43**. In analogous fashion, corresponding radial slots **38''** may be provided to clear but radially overlap the breaker elements **45** as they pass the barrier **38**.

The drum or grid **41** is also mounted on a common axis with drums **25**–**40** but for greater fragmenting effectiveness the drum **41** is independently rotatable, being driven in the opposite direction (counterclockwise, in the sense of FIG. **1**) by an edge driving pinion connection to a ring gear **48** forming part of drum **41**. The phantom connection **33'** in FIG. **2** will be understood to identify such a drive from the power source **32** which drives drum **25**. Rotary support for drum **41** is provided by bearing means **49** at the rim of the opening in wall **28**, and by spaced positioning rolls **50** on the rear frame plate **37**. As with drum **40**, the drum or grid **41** is open-ended and characterized by plural spaced slotted openings **51** in its wall. Two sets of breaker lugs **52** project radially outwardly of drum **41** and radially overlap and clear slotted openings **53** in spaced radially inward, axially extending blades **54**, forming inner structure of the drum **40**.

As indicated, fragmented material passing through or reduced by the stage **40**–**41** is received by chute **21** and conveyed from span A to span B, where it is deposited on the inner surface of a further drum **55** secured to and carried by the plate or wall **28** of drum **25**. The inner surface of drum **55** preferably includes ribs, corrugations or other projections to engage such fragments sufficiently to raise them upwardly, in the course of movement of drum **25** (and **55**). On the way up, the fragments must pass or be further reduced at a final restrictive passage, defined by the relatively close clearance relation between a fixed breaker element **56** and the path of upward movement of the inner surface of drum **55**. A supporting bracket structure **57** is shown spanning opposed uprights of the frame **20** to provide a fixed reference for the breaker element **56**.

It will be seen that the fragmentation at **55**–**56** represents a third stage of reduction and that material passing this restriction will gravitationally fall for collection by the second or delivery chute **22**. As suggested in FIG. **2**, the reduction at this point may be sufficient to enable conveyance to a desired truck or other storage region, or it is sufficiently uniform in its reduction to permit more tolerant acceptance by further reduction or compacting means on the vehicle or otherwise associated with the reduction means of my invention.

It will be seen that I have described improved refuse-compacting mechanism which operates, in successive stages of reduction, to progressively shred or break random bulky material, as is encountered in residential and other refuse collection. Because the material is fragmented to a relatively fine state, a substantial improvement in volume reduction is achieved without resorting to any pressure-type compaction techniques. The material stores itself in more compact form, thereby achieving greater loads per vehicle, with resultant fewer round trips per day to the dump. The material deposited at the dump requires less volume and no roller or other special techniques for settling. The order of magnitude of volume reduction may be in the range of 5:1 to 10:1, for ordinary household, residential collections. Moreover, this reduction is achieved without noticeable increase in noise over present compactor-type vehicles, since the rotating parts are substantially enclosed, and they rotate relatively slowly, depending for their effectiveness upon high mechanical advantage in the drive of relatively high mass, rugged, rotating parts.

Although the invention has been described in detail for the preferred form shown, it will be understood that modifications may be made within the scope of the invention. For example, various combinations of blades and scrapers may be provided in each of the different stages of reduction, the important point being that plural reduction stages are presented to a steady flow of input material, all contained within or carried by the same basic rotating structure of drum **25**. Also, fenders, guards, seals and the like are provided to assure clean retention of fragmented material at its correct stages, as suggested for example by the fixed bracket or plate **58** (FIG. **3**) extending over the upward arc of movement of drum **25**; plate **58** extends in adjacent radial overlap with the generally open end **27** of drum **25**, to substantially the limited radial extent of adjacent ends of blades **35**, and it serves to retain dropped fragments within the pick up region swept by blades **35**.

I claim:

1. Refuse-processing means, comprising a first drum with a closed outer wall and having a generally open end and a generally closed end, means supporting and rotating said drum on a generally horizontal axis, feed means communicating with the lower part of the generally open end of said drum for feeding refuse therein as said drum is rotated past an in feed location, the inner surface of said drum including radially inwardly extending refuse-engaging means for elevating refuse during the course of drum rotation from the in feed location to an upper location, first fixed constriction means positioned in a predetermined first clearance relation with the inner surface

of said drum at a location intermediate the in feed location and said upper location during the course of movement to said upper location, whereby refuse of size to be fouled by the constriction at said clearance will be subjected to a first stage of breaking action prior to passage through said clearance; a second drum within said first drum and including an outer wall having circumferentially distributed openings therein, and means supporting and rotating said second drum on a generally horizontal axis, second constriction means positioned in a predetermined second clearance relation with the outer surface of said second drum in the range between said upper and lower locations, said second clearance and the constricting dimension of said openings being less than said first clearance, whereby refuse passing through said openings may have been subjected to a second stage of breaking action at said second clearance; and refuse-removal means within said second drum and poised to receive refuse passed by said openings.

2. Refuse-processing means according to claim 1, in which said drums are rotated in opposite directions.

3. Refuse-processing means according to claim 2, in which said first and second constriction means are at generally opposed sides of the axes of said drums.

4. Refuse-processing means according to claim 1, in which said drums are on a common axis.

5. Refuse-processing means according to claim 1, in which said first constriction means comprises plural angularly spaced constrictor elements having progressively decreasing clearance with said first drum in the direction of first-drum rotation.

6. Refuse-processing means according to claim 1, in which said second constriction means comprises plural angularly spaced constrictor elements having progressively decreasing clearance with said second drum in the direction of second-drum rotation.

7. Refuse-processing means according to claim 1, in which said second constriction means includes a generally cylindrical grid carried by said first drum and interposed between said second drum and the wall of said first drum.

8. Refuse-processing means according to claim 7, in which third constriction means is fixedly positioned in a predetermined third clearance relation with the outer profile of said grid, whereby a further stage of breaking action may be operative upon refuse passing said first constriction and prior to passage through said grid.

9. Refuse-processing means according to claim 8, in which said grid and said further constriction means include radially overlapping but axially clearing elements at angularly spaced locations.

10. Refuse-processing means according to claim 8, in which said grid and said second drum include radially overlapping but axially clearing elements at angularly spaced locations.

11. Refuse-processing means according to claim 1, in which said feed means is a hopper communicating with the lower part of said first drum.

12. Refuse-processing means according to claim 1, and including a fixed upstanding wall facing and substantially closing the end of said first drum in the region above said feed means.

13. Refuse-processing means according to claim 12, in which said wall includes a generally radially and axially extending barrier element in relatively close radial clearance with said grid and near the top of the path of grid movement.

14. Refuse-processing means according to claim 1, in which said first drum is generally frustoconical with said generally open end the larger end.

15. Refuse-processing means according to claim 1, in which said radially inwardly extending refuse-engaging means includes a plurality of generally axially and radially extending blade elements at angularly spaced locations.

16. Refuse-processing means according to claim 1, in which the substantially closed end of said first drum includes a central opening and in which said refuse-removal means includes a discharge element extending through said central opening.

17. Refuse-processing means according to claim 16, in which a third rotary drum is positioned axially adjacent the generally closed end of said first drum and in which said discharge element extends into said third drum for discharge therein, a third constriction element fixed against rotation and positioned in predetermined relatively close clearance relation with the inner wall of said third drum for establishing a third stage of breaking action operative upon refuse received from said discharge element, and further refuse-removal means within said third drum and poised to receive refuse passed by said third constriction element.

18. Refuse-processing means according to claim 16, in which said third drum is carried by said first drum at the generally closed end thereof.

19. Refuse-processing means, comprising a drum with a closed outer wall and having a generally open end and a generally closed end, means supporting and rotating said drum on a generally horizontal axis, feed means communicating with the lower part of the generally open end of said drum for feeding refuse therein as said drum is rotated past an in feed location, the inner surface of said drum including radially inwardly extending refuse-engaging means for elevating refuse during the course of drum rotation from the in feed location to an upper location, fixed constriction means positioned in predetermined clearance relation with the inner surface of said drum and intermediate the in feed location and said upper location during the course of movement to said upper location, whereby refuse of size to be fouled by said constriction means will be subjected to breaking action prior to passage past said clearance relation; a second drum within said first drum and including an outer wall having circumferentially distributed openings therein, and refuse-removal means within said drum and poised to receive refuse that has passed said clearance relation.