United States Patent

Rossler

[15] **3,662,964**

[45] **May 16, 1972**

[54] COMMINUTING MACHINE

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[22] Filed: **Dec. 2, 1970**

[21] Appl. No.: **94,418**

[30] **Foreign Application Priority Data**

Dec. 10, 1969 Germany ..... P 19 61 820.3
Oct. 7, 1970 Germany ..... P 20 49 124.1

[52] **U.S. Cl.** **241/222,** 241/236
[51] **Int. Cl.** **B02c 7/04,** B02c 18/40, B02c 13/20
[58] **Field of Search** 241/143, 190, 222, 235, 236, 241/243, 261

[56] **References Cited**

UNITED STATES PATENTS

289,025	11/1883	Penfield	241/236 X
3,151,645	10/1964	Hesse	241/236 X
3,396,914	8/1968	Liebman	241/236 X
3,548,742	12/1970	Seufert et al.	241/236 X
3,578,252	5/1971	Brewer	241/243 X

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[57] **ABSTRACT**

A comminuting machine for metallic, plastic, vitreous, textile, ligneous or other scrap has a pair of horizontal shafts mounted in a housing below a material-admitting inlet and carrying stacks of ring-shaped frustoconical comminuting members provided with alternating tooth spaces and teeth which entrain and fragmentize the material during passage between the shafts. The larger diameter ends of the comminuting members have polished end faces surrounded by cutting edges, and the comminuting members of one of the stacks are inverted with reference to comminuting members of the other stack. The cutting edges of comminuting members of one of the stacks slightly overlap the cutting edges on comminuting members of the other stack. The teeth of comminuting members in each stack form one or more helices. The shafts are driven at the same speed but in opposite directions so as to rotate the comminuting members from above through and below the space between the shafts. The comminuted material passes through the slots of a removable grate which is secured to the housing below the shafts.

24 Claims, 8 Drawing Figures

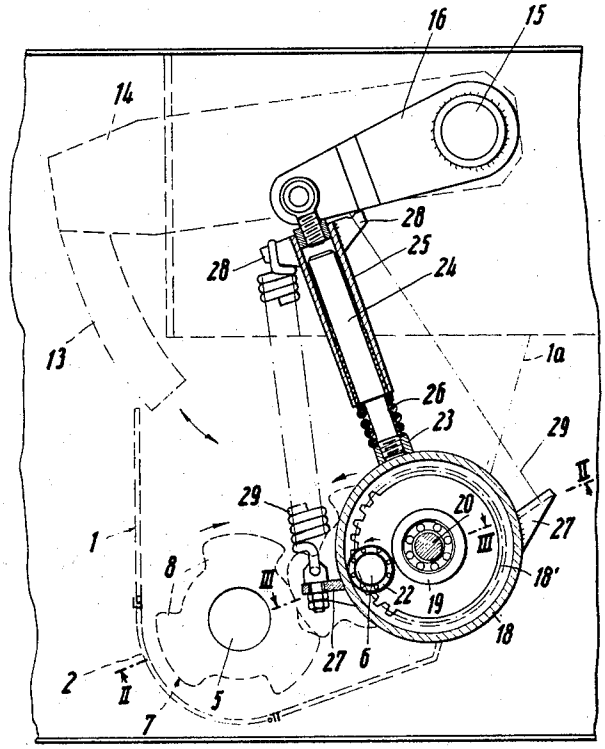

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Fig. 1

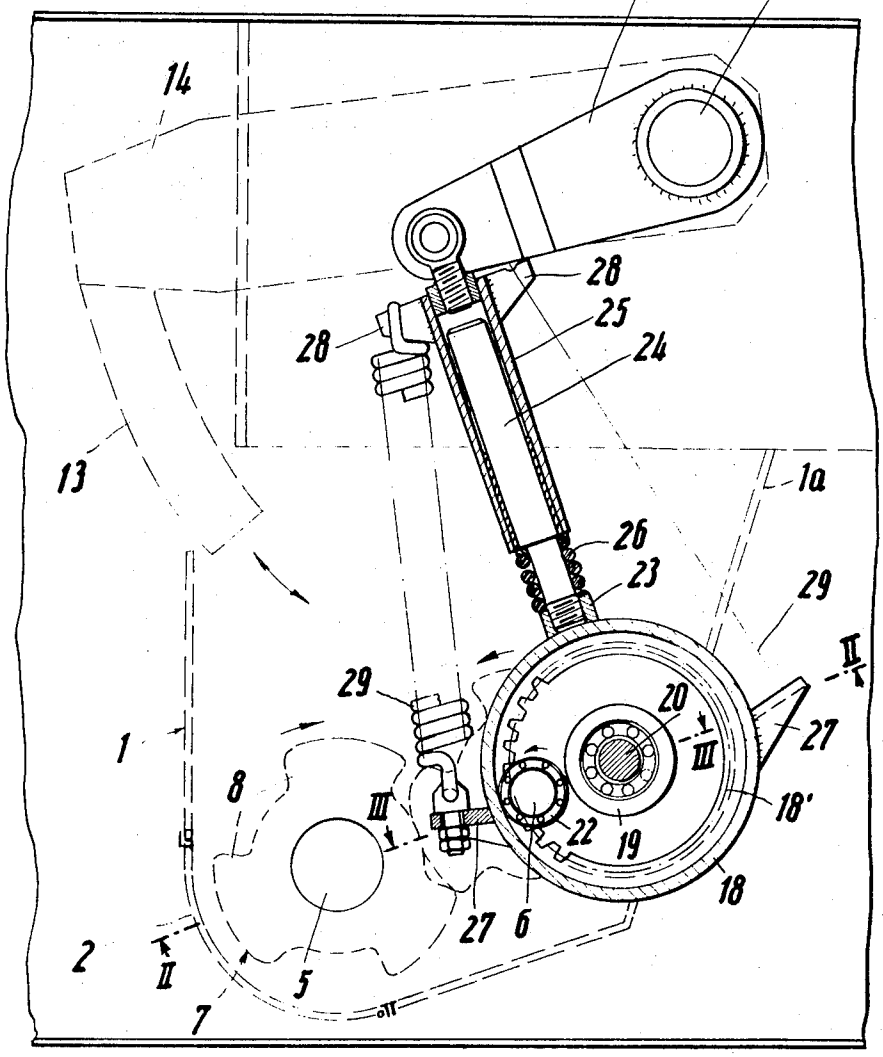

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Fig. 2

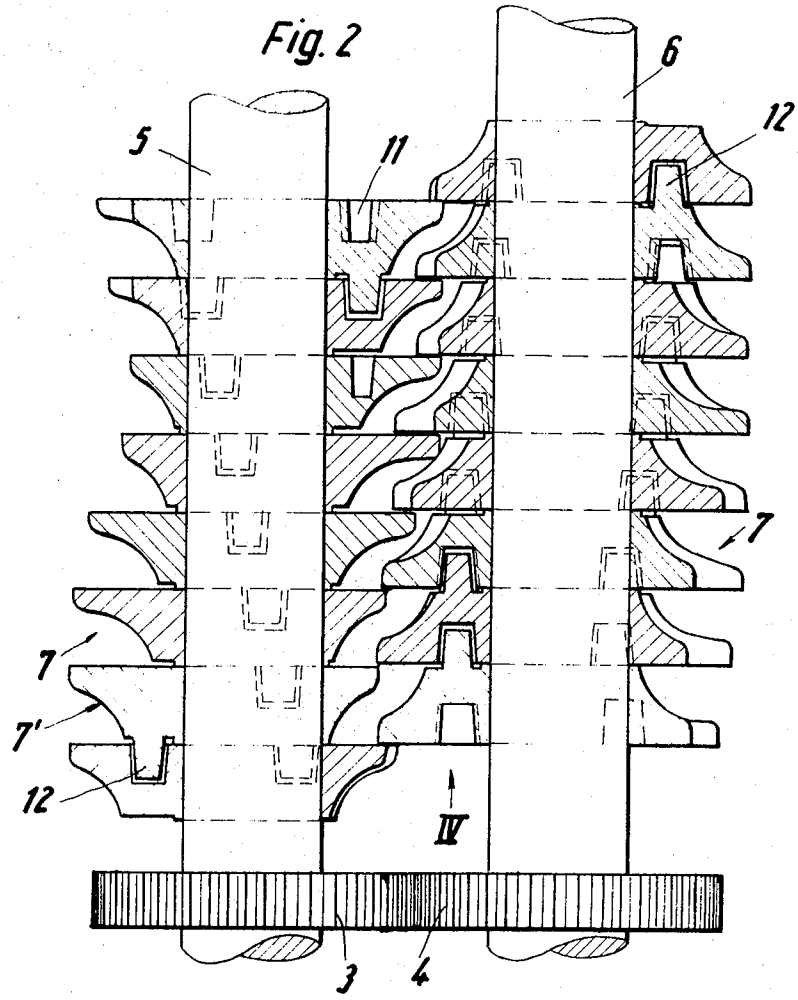

Fig. 3

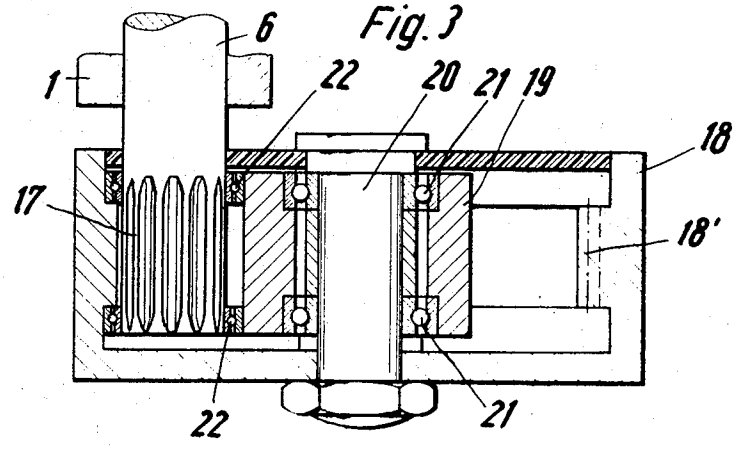

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Fig. 4

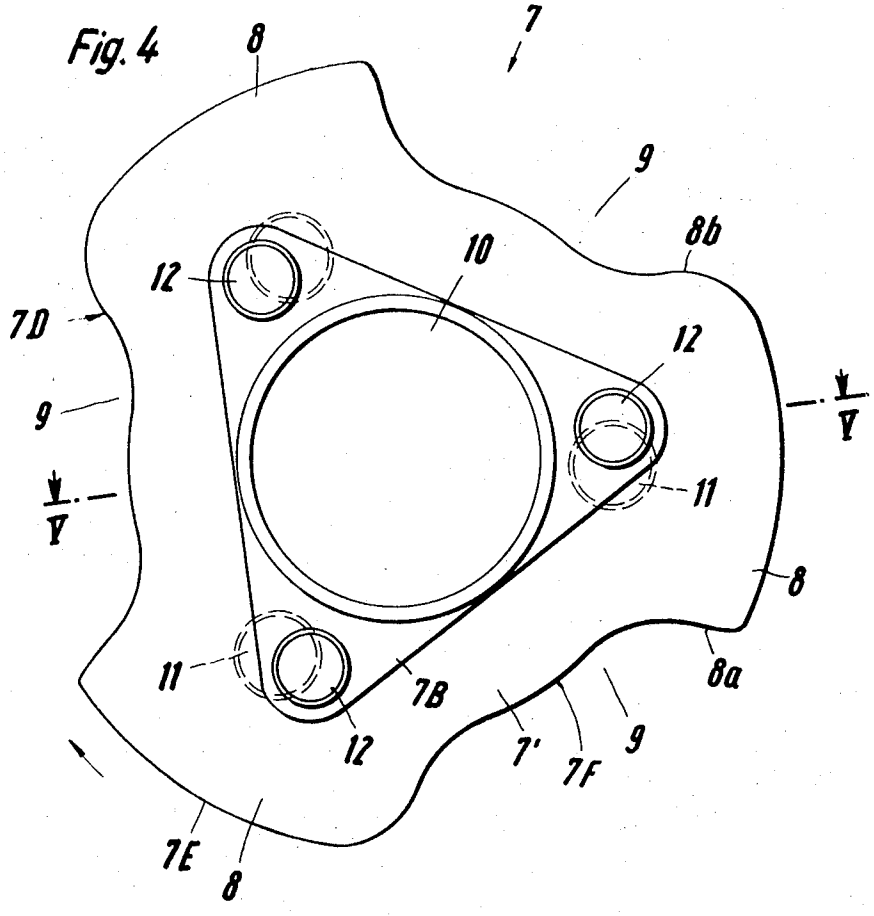

Fig. 5

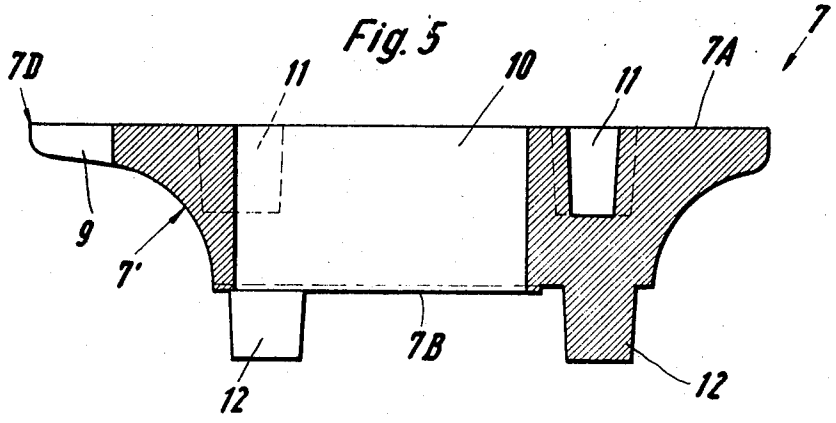

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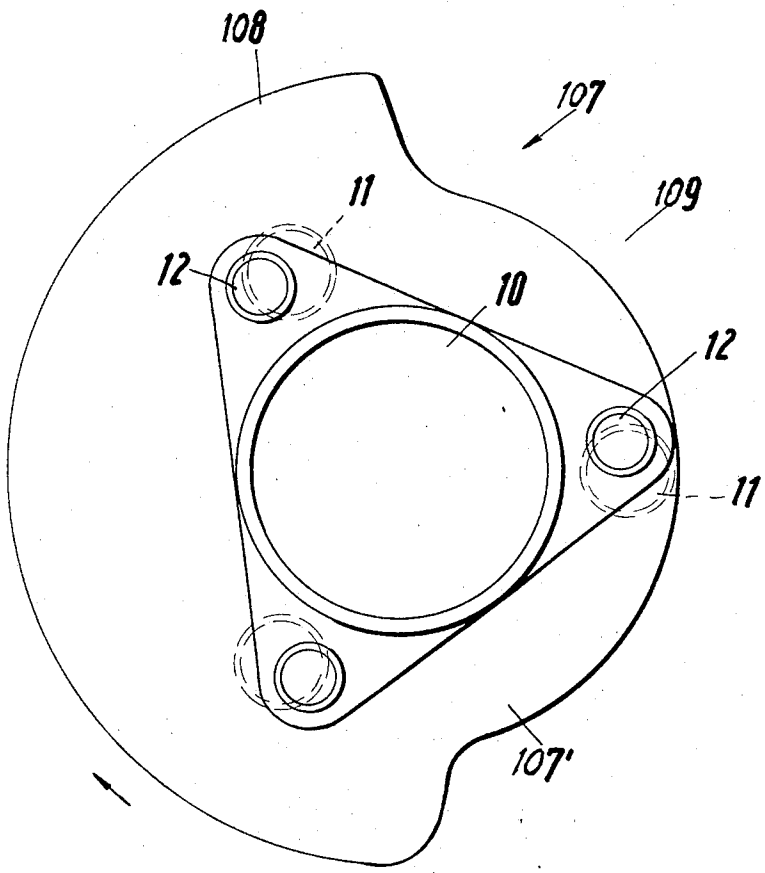
Fig. 4a



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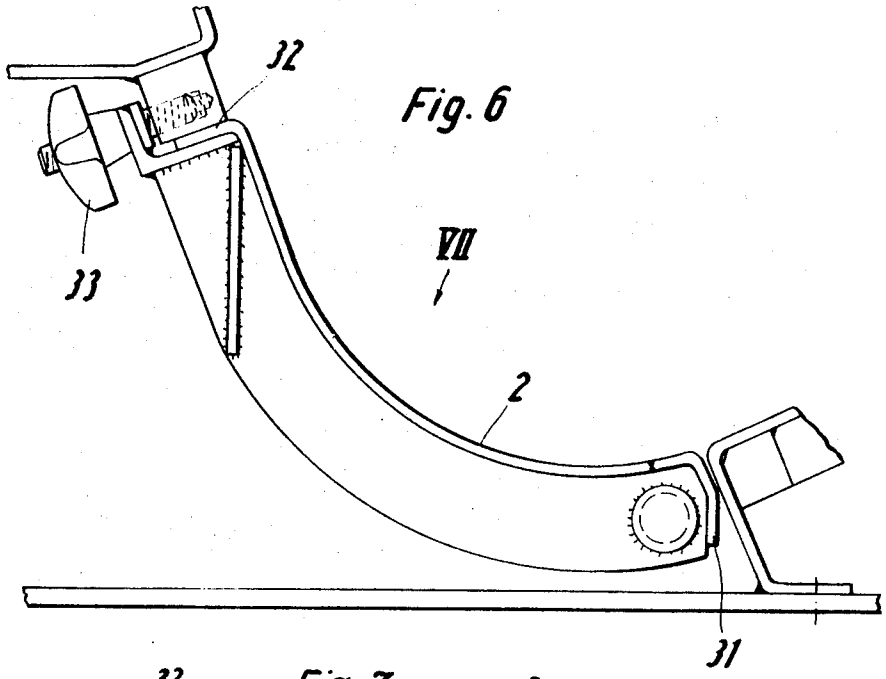

Fig. 6

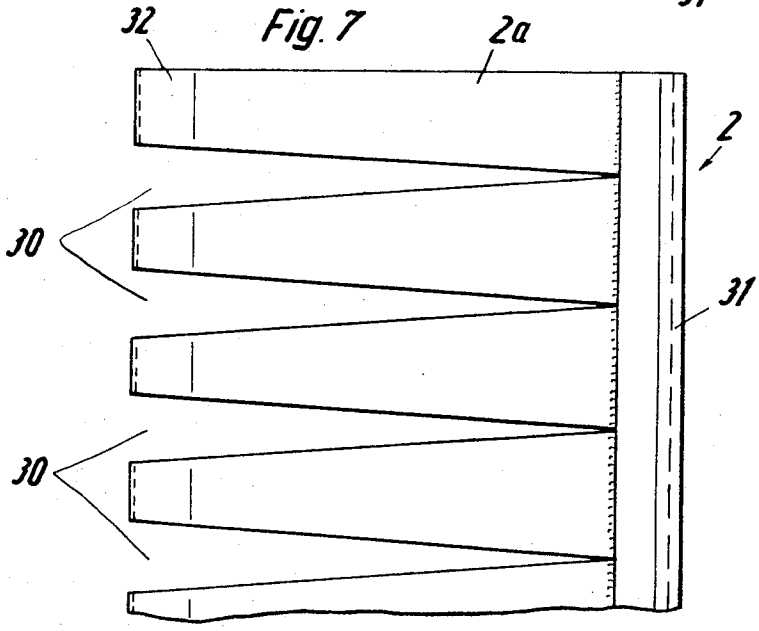

Fig. 7

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COMMINUTING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to comminuting machines in general, and more particularly to improvements in machines for fragmentizing garbage, scrap and/or other bulky objects or articles which constitute waste and may consist of metallic, ligneous, plastic, vitreous, textile and/or other material. Still more particularly, the invention relates to improvements in comminuting machines of the type wherein two parallel shafts which rotate in opposite directions carry coacting comminuting members and the material is fragmentized while it passes between the shafts.

A drawback of presently known comminuting machines wherein the material to be comminuted passes between two shafts which carry comminuting members is that the energy requirements of the prime mover which drives the shafts are very high or that the output is too low. Furthermore, known comminuting machines are designed for fragmentizing of a certain type of material so that the material which is to be fragmentized must be segregated from other materials. For example, scraps of metal cannot be fragmentized with scraps of wood, glass or the like.

SUMMARY OF THE INVENTION

An object of the invention is to provide a comminuting machine which can fragmentize a variety of relatively small or bulky objects, particularly refuse or scrap consisting of one or more materials and whose energy requirements are lower than those of presently known comminuting machines.

Another object of the invention is to provide the comminuting machine with novel comminuting members which are designed in such a way that the material to be fragmentized cannot accumulate in the comminuting zone and which can fragmentize with equal facility objects consisting of vitreous, metallic, plastic, ligneous and/or textile material.

A further object of the invention is to provide a comminuting machine wherein the parts are mounted and constructed in such a way that they are protected from excessive stresses and that the stresses on such parts fluctuate relatively little or not at all.

An additional object of the invention is to provide the comminuting machine with novel and improved means for feeding the material to be fragmentized into the range of comminuting members.

Still another object of the invention is to provide the comminuting machine with readily accessible and sturdy comminuting members which can stand long periods of use and can be rapidly mounted on or detached from their carriers.

The improved comminuting machine comprises a housing having a preferably funnel-shaped material admitting inlet, a pair of at least substantially parallel preferably horizontal shafts which are rotatably mounted in the housing, preferably in such a way that one of the shafts is located at a level slightly below the other shaft, stacks of annular comminuting members secured to the shafts, and drive means for rotating the shafts in opposite directions so that the material which is admitted by way of the inlet and enters the range of projections provided on the comminuting members is comminuted during passage between the shafts.

Each comminuting member has a plane end face which is closely or immediately adjacent to the end face of a comminuting member of the other stack and is at least substantially normal to the axis of the respective shaft. Furthermore, each comminuting member comprises a cutting edge which surrounds the respective end face, at least one substantially radially outwardly extending preferably segment-shaped projection or tooth and at least one radially inwardly extending recess or tooth space. The cutting edge of each comminuting member in one of the stacks overlaps the cutting edge of the adjoining comminuting member in the other stack. The overlap is preferably small, for example, in the range of 1 or more millimeters.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved comminuting machine itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary side elevational view of a comminuting machine which embodies the invention, certain parts of the machine being shown in vertical section;

FIG. 2 is a slightly enlarged sectional view as seen in the direction of arrows from the line II—II of FIG. 1;

FIG. 3 is a greatly enlarged sectional view as seen in the direction of arrows from the line III—III of FIG. 1;

FIG. 4 is an enlarged end elevational view of a comminuting member as seen in the direction of arrow IV in FIG. 2;

FIG. 4*a* is a similar end elevational view of a modified comminuting member;

FIG. 5 is a sectional view as seen in the direction of arrows from the line V—V of FIG. 4;

FIG. 6 is an enlarged view of a detail in FIG. 1; and

FIG. 7 is a view as seen in the direction of arrow VII in FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The comminuting apparatus of FIG. 1 comprises a substantially rectangular housing 1 having a preferably funnel-shaped inlet 1*a* which can admit scrap into the range of projections or teeth 8 provided on annular metallic comminuting members 7 which are secured to two parallel horizontal shafts 5, 6. These shafts are mounted in the housing 1 and are rotatable in opposite directions as indicated by arrows by means of a drive mechanism which includes mating spur gears 3, 4 (FIG. 2). The shafts 5, 6 are preferably rotated at identical speeds. The space below the shafts 5, 6 is partially closed by an arcuate bottom wall or grate 2 which permits comminuted or fragmentized particles to descend into a receptacle or the like, not shown. The axes of the shafts 5, 6 are horizontal and FIG. 1 shows that the shafts are mounted at different levels.

As shown in FIG. 2, each of the shafts 5, 6 carries a stack of eight coaxial annular comminuting members 7. The comminuting members of the stack on the shaft 5 are inverted with reference to comminuting members of the stack on the shaft 6. Each comminuting member 7 has a precision-finished (preferably polished) larger end face 7A and a smaller end face 7B (see FIGS. 4 and 5). These end faces are normal to the axes of the respective shafts and the end face 7A of each comminuting member 7 on the shaft 5 is closely adjacent to the end face 7A of a comminuting member on the shaft 6. Furthermore, each member 7 comprises three radially outwardly extending equidistant projections or teeth 8 which alternate with radially inwardly extending recesses or tooth spaces 9. The end face 7A of each comminuting member 7 is bounded by a sharp cutting edge 7D. Each cutting edge 7D has arcuate portions 7E which are provided on the projections 8 and arcuate portions 7F in the recesses 9. The center of curvature of each arcuate portion 7E, 7F is preferably located on the axis of the respective shaft. The front flanks 8*a* of the projections 8 (as considered in the direction of rotation of the respective comminuting member 7) extend substantially radially and the rear flanks 8*b* of such projections are of convex shape with gradual transition into the surfaces bounding the adjacent recesses 9. Each comminuting member 7 has an axial bore 10 for the respective shaft 5 or 6. The manner in which the comminuting members 7 are secured to the respective shafts is not shown in the drawing.

The end face 7A of each comminuting member 7 is provided with three equidistant inwardly tapering blind bores or sockets 11. The centers of these sockets are located on a circle

whose center is located on the axis of the respective comminuting member. The second end face 7B of each comminuting member 7 is provided with three equidistant conical protuberances or studs 12 which are angularly offset with reference to the respective sockets 11 by about 8°–10°. The centers of the studs 12 are located on the circle of the centers of the respective sockets. When the comminuting members 7 are assembled into a stack (FIG. 2), the studs 12 of one member 7 extend into the sockets 11 of the adjacent member 7 whereby the adjoining members 7 are angularly offset with reference to each other so that their projections 8 form three helices. The distance between the axes of the shafts 5, 6 is selected in such a way that the cutting edge 7D of a comminuting member 7 on the shaft 5 slightly overlaps the cutting edge 7D of the adjacent comminuting member 7 on the shaft 6. FIG. 2 further shows that the space between the shafts 5, 6 invariably accommodates a projection or recess of a comminuting member 7 on the shaft 5 and a recess or projection of a comminuting member 7 on the shaft 6. The overlap of the end faces 7A on the adjoining comminuting members of the stacks on the shafts 5 and 6 is preferably in the range of 1 or more millimeters. The overlapping portions of neighboring cutting edges move back and forth in response to rotation of the shafts 5 and 6 to thus entrain the admitted material into the fragmentizing zone between the shafts with relatively small expenditures of energy.

When the drive means for the shafts 5, 6 is in operation, the front flanks 8*a* of the projections 8 entrain the material to be comminuted toward and through the space between the shafts 5, 6 whereby the material is subjected to a thorough comminuting or fragmentizing action.

Since the sockets 11 and studs 12 of the comminuting members 7 are angularly offset with reference to each other, the helically distributed projections 8 of the stacks on the shafts 5, 6 ensure that the entraining and fragmentizing action of the comminuting members is constant in each angular position of each shaft. This brings about substantial savings in energy requirements of the motor which drives the shaft 5 and/or 6. The helices formed by the projections 8 can resemble left-hand or right-hand threads. Such helicoidal distribution of projections 8 ensures that the stresses upon the motor which drives the shafts 5, 6 fluctuate very little or not at all. It was found that the improved comminuting machine can use a prime mover which is much smaller and whose energy requirements are substantially less than the dimensions and energy requirements of prime movers in presently known comminuting machines having the same output.

The peripheral surface 7′ (see FIG. 5) of each comminuting member 7 tapers in the axial direction of the respective shaft from the end face 7A toward the end face 7B. Such configuration enhances the stability of the comminuting members and prevents retention of objects to be comminuted between the two stacks of comminuting members. For example, it was found that stockings or like textile articles are prevented from coiling themselves around the comminuting members 7 during transport through the space between the shafts 5 and 6. Also, the frustoconical shape of the comminuting members 7 ensures that the fragments cannot dwell and cannot become compacted in the space between the two shafts.

Referring to FIGS. 1 and 3, there is shown a feeding mechanism which is employed to advance the objects which are admitted by way of the inlet 1*a* into the range of projections 8 on the comminuting members 7. Such feeding mechanism comprises an elongated arcuate pusher 13 which extends lengthwise of the shafts 5, 6 and can move through an opening in the housing 1 between two end positions in one of which (see FIG. 1) the pusher is at least substantially withdrawn from the housing 1. The actuating means for imparting to the pusher 13 oscillatory movements at a desired frequency comprises a horizontal shaft 15 which is rotatably mounted in the housing 1 in parallelism with the shafts 5, 6 and is rigid with the arm 14 of the pusher 13. The shaft 15 is further rigidly connected with a lever 16 which receives motion from the shaft 6. The arm 14 of the pusher 13 is outwardly adjacent to the rear side wall of the housing 1 and the lever 16 of the actuating means is outwardly adjacent to the front side wall of the housing, as viewed in FIG. 1.

The transmission which oscillates the shaft 16 (and hence the pusher 13) in response to rotation of the shaft 6 comprises a pinion 17 (FIG. 3) which is integral with one end of the shaft 6 and an eccentric casing 18 whose internal gear 18′ meshes with the pinion 17. The diameter of the pitch circle of the internal gear 18′ is a multiple (e.g., four or five times) the diameter of the pitch circle of the pinion 17. The internal gear 18′ is maintained in mesh with the pinion 17 by a distancing ring 19 which is rotatable on antifriction bearings 21 surrounding a post or bolt 20 which is mounted in and is coaxial with the casing 18. The pinion 17 is disposed between antifriction bearings 22 having outer races which are engaged by the distancing ring 19 and inner races surrounding the shaft 6. The outer races of the bearings 22 are further engaged by internal cylindrical surfaces provided in the casing 18 adjacent to the axial ends of the internal gear 18′. Such mounting of the eccentric casing 18 on the shaft 6 ensures proper engagement between the gear 18′ and the pinion 17.

The casing 18 has a radially outwardly extending internally threaded nipple 23 for an externally threaded end of a shaft 24 which extends into an elongated cylindrical sleeve 25. The parts 24, 25 form a variable-length rod which connects the lever 16 with the eccenric casing 18. The upper end portion of the sleeve 25 is articulately connected to the free end of the lever 16. A helical spring 26 acts between the lower end face of the sleeve 25 and the nipple 23 so as to urge the shaft 24 in a direction away from the lever 16, i.e., to lengthen the rod 24, 25.

The casing 18 carries two lugs 27 which are located substantially diametrically opposite each other and are connected with the lower ends of resilient elements here shown as helical springs 29. The upper ends of the springs 29 are connected to lugs 28 provided on the upper end portion of the sleeve 25. The springs 29 are mounted in prestressed condition. Thus, the lever 16 stresses one of the springs 29 when it turns in one direction and the other spring 29 is stressed in response to turning of lever 16 in the other direction. When the shaft 6 rotates and the internal gear 18′ rolls along the pinion 17, the pusher 13 performs alternating compacting and retraction strokes. The compacting action of the pusher 13 is a function of the stress of springs 29. These springs prevent damage to or deformation of parts of the comminuting machine by limiting the pressure which the pusher 13 can apply to the material which is admitted by way of the inlet 1*a*. The stress of the springs 29 is sufficient to insure that the pusher 13 can readily advance bulky parts into the range of the projections 8 and to hold such parts until the comminuting action begins, i.e., until a bulky part starts to disintegrate and to pass between the shafts 5 and 6.

As shown in FIG. 1, the pusher 13 is preferably of arcuate shape and the center of curvature of its arcuate surfaces is preferably located on the axis of the shaft 15. When the actuating means moves the pusher to the illustrated retracted position in which at least the major part of the pusher extends from the housing 1, the material which is admitted by way of the inlet 1*a* can readily descend onto the two stacks of comminuting members 7 on the shaft 5 and 6. The transmission which oscillates the lever 16 and the pusher 13 is designed in such a way that the frequency at which the pusher penetrates into the housing 1 is rather low. This ensures that, while moving toward its other end position (in the housing 1), the pusher 13 acts not unlike a metering device which prevents the delivery of material to the comminuting members at an excessive rate. The pusher 13 preferably performs one working stroke in response to several revolutions of the shaft 6.

The feeding mechanism prevents relatively bulky objects from riding on the comminuting members 7 in the zone above the space between the shafts 5 and 6. Such bulky objects may include empty cans consisting of sheet metal or the like.

The manner in which the bottom wall **2** is mounted in the housing **1** below the shafts **5** and **6** is illustrated in FIG. **6**. The center of curvature of the bottom wall **2** is preferably located on the axis of the shaft **5** which is mounted at a level below the shaft **6**. As shown in FIG. **7**, the bottom wall **2** is formed with triangular or wedge-like slots **30** alternating with ribs **2** and providing passages for evacuation of fragments. The width of the slots **30** increases in the direction of rotation of the shaft **5**. The ends of the bottom wall **2** are provided with outwardly bent flanges **31, 32** which are separably secured to the housing **1** to ensure that the illustrated bottom wall can be readily detached in order to afford access to the shafts **5, 6** or to be replaced with a bottom wall having differently configurated and/or dimensioned slots. The means for separably securing the flanges **31, 32** to the housing **1** may comprise wing nuts **33** or the like.

The improved comminuting machine is susceptible of many further modifications without departing from the spirit of the present invention. For example, each comminuting member **7** can be provided with a single projection or with two, four or more equidistant projections. If each comminuting member comprises a single projection and a single recess, the projection and the recess preferably extend along arcs of about **180** degrees. It is further clear that the number of comminuting members on the shafts **5, 6** can be smaller or greater than shown in FIG. **2**.

FIG. **4***a* shows a comminuting member **107** having a single projection or lobe **108** and a single recess **109**, each extending along an arc of about 180°. The reference character **107'** denotes the tapering peripheral surface of the comminuting member **107**. The reference characters **10, 11** and **12** of FIG. **4***a* denote parts which are identical with similarly referenced parts of the comminuting member **7**.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. A comminuting machine, particularly for fragmentizing scrap consisting of metallic, plastic, ligneous, vitreous and/or textile material, comprising a housing having material-admitting inlet means; a pair of at least substantially parallel shafts rotatable in said housing; stacks of annular comminuting members secured to said shafts, each comminuting member having a plane end face closely adjacent to the end face of a member of the other stack and at least substantially normal to the axis of the respective shaft, a cutting edge surrounding the end face, at least one substantially radially outwardly extending projection and at least one substantially radially inwardly extending recess, the cutting edge of each member of one of said stacks partially overlapping the cutting edge of a member of the other stack; and drive means for rotating said shafts in opposite directions so that the material which is admitted by way of said inlet means and enters the range of said projections is comminuted during passage between said shafts.

2. A machine as defined in claim **1**, wherein said drive means is arranged to rotate said shafts at identical speeds.

3. A machine as defined in claim **1**, wherein the comminuting members of one of said stacks are inverted with reference to the comminuting members of the other stack.

4. A machine as defined in claim **1**, wherein each comminuting member comprises a single projection and a single recess each extending along an arc of about 180°.

5. A machine as defined in claim **1**, wherein each comminuting member comprises a plurality of equidistant projections and a plurality of recesses which alternate with said projections, as considered in the circumferential direction of the respective shaft.

6. A machine as defined in claim **1**, wherein each of said comminuting members has a peripheral surface which tapers axially of the respective shaft in a direction away from the respective end face.

7. A machine as defined in claim **1**, wherein each of said cutting edges comprises an arcuate portion provided on the respective projection and an arcuate portion in the respective recess, the radii of curvature of such arcuate portions being located on the axes of the respective shafts.

8. A machine as defined in claim **1**, wherein the projections of at least some comminuting members in each of said stacks are angularly offset with reference to each other so that such projections form at least one helix.

9. A machine as defined in claim **1**, wherein each comminuting member comprises a second end face which is at least substantially parallel to the first mentioned end face, one end face of each comminuting member having at least one socket and the other end face of each comminuting member having at least one protuberance received in the socket of the adjoining comminuting member.

10. A machine as defined in claim **9**, wherein said protuberances are of conical shape and said sockets are angularly offset with reference to the protuberances of the respective comminuting members.

11. A machine as defined in claim **1**, further comprising feeding means for urging the material which is admitted by way of said inlet means into the range of projections on said comminuting members.

12. A machine as defined in claim **11**, wherein said feeding means comprises an elongated pusher extending lengthwise of said shafts and actuating means for imparting to said pusher recurrent movements in a direction to advance the material which is admitted by way of said inlet means toward the projections of said comminuting members.

13. A machine as defined in claim **12**, wherein said pusher is pivotable about a predetermined axis which is parallel to the axes of said shafts and said actuating means comprises a lever rigid with said pusher and pivotable about said predetermined axis, and transmission means for oscillating said lever, said lever being arranged to oscillate said pusher to and from an end position in which the pusher is at least partially withdrawn from said housing.

14. A machine as defined in claim **13**, wherein said transmission means comprises an eccentric and resilient means coupling said eccentric with said lever.

15. A machine as defined in claim **14**, wherein said eccentric derives motion from one of said shafts.

16. A machine as defined in claim **15**, wherein said one shaft has a pinion and said eccentric comprises an internal gear meshing with said pinion, said transmission means further comprising a distancing member concentrically mounted in said eccentric for maintaining said internal gear in mesh with said pinion.

17. A machine as defined in claim **16**, wherein said transmission means further comprises a variable-length rod connecting said eccentric with said lever.

18. A machine as defined in claim **17**, wherein said transmission means further comprises spring means tending to increase the length of said rod.

19. A machine as defined in claim **18**, wherein said resilient means comprises at least one prestressed spring connecting said eccentric with said lever.

20. A machine as defined in claim **1**, wherein said shafts are substantially horizontal and further comprising a grate secured to said housing below said shafts.

21. A machine as defined in claim **20**, wherein one of said shafts is located at a level below the other shaft, said grate being of arcuate shape with a center of curvature located at least close to the axis of said one shaft.

22. A machine as defined in claim **21**, wherein said grate is provided with slots whose width increases in the direction of rotation of said one shaft.

23. A machine as defined in claim 20, wherein said grate comprises outturned flanges secured to said housing.

24. A machine as defined in claim 20, further comprising means for separably connecting said grate to said housing.

* * * * *