United States Patent

[11] **3,589,627**

[72] Inventor **James L. Torrence**
St. Louis, Mo.

[21] Appl. No. **777,736**
[22] Filed **Nov. 21, 1968**
[45] Patented **June 29, 1971**
[73] Assignee **American Pulverizer Company**
St. Louis, Mo.

[54] **REDUCTION MILL**
11 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **241/186,** 241/190, 241/195
[51] **Int. Cl.** **B02c 13/06,** B02c 13/20, B02c 13/286
[50] **Field of Search** ..... 241/63, 167, 186.7, 190, 195, 101.5, 101, 236, DIG. 22, 223, 229, 243, 189, 154; 146/118

[56] **References Cited**

UNITED STATES PATENTS

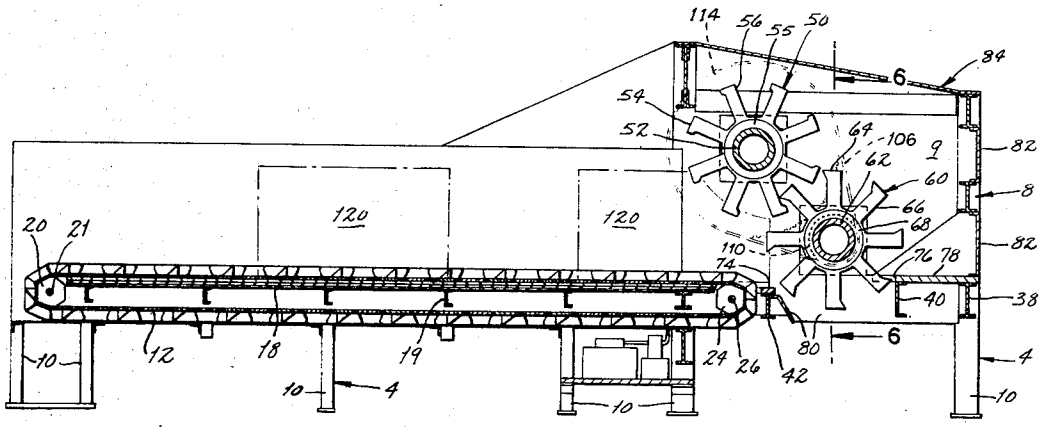
1,439,781	12/1922	Williams	241/189
1,840,749	1/1932	Stresau	241/186 X
2,453,008	11/1948	Fowler	241/186 X
2,685,900	8/1954	Cross	146/118
2,839,254	6/1958	Smith	241/154
3,170,642	2/1965	Haidler	241/186
3,426,674	2/1969	Testolin	241/186 X
3,486,704	12/1969	Persky	241/167

FOREIGN PATENTS

224,930	10/1959	Australia	241/186

Primary Examiner—Donald G. Kelly
Attorney—Gravely, Lieder & Woodruff

ABSTRACT: A reduction mill having a reduction cage in which a feed roll and shredding roll revolve. An endless conveyor extends into the cage beneath the feed roll and terminates in close proximity to the path described by the shredding roll.



PATENTED JUN 29 1971

3,589,627

SHEET 1 OF 3

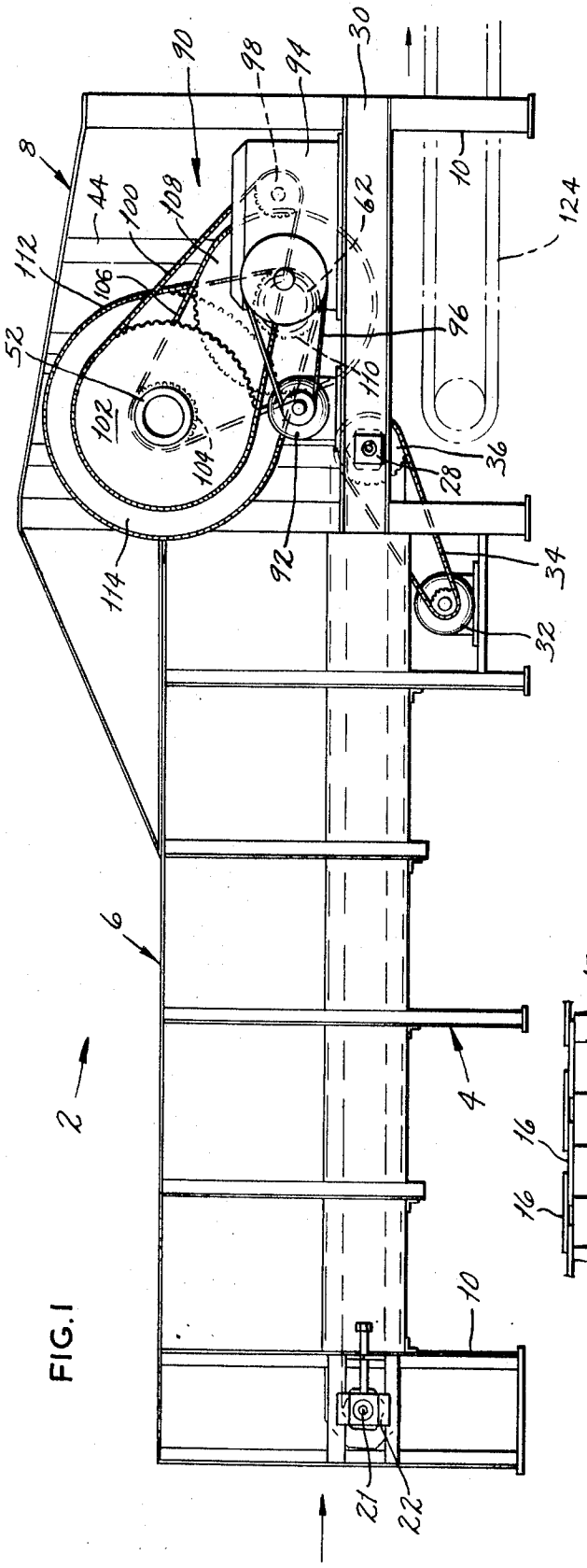


FIG. 1

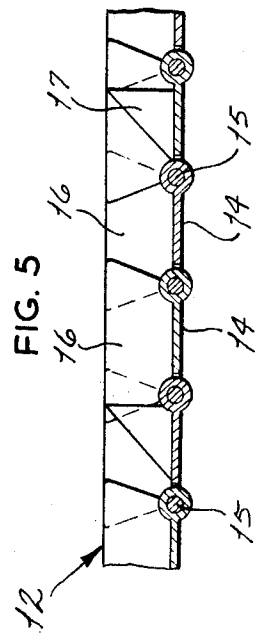


FIG. 5

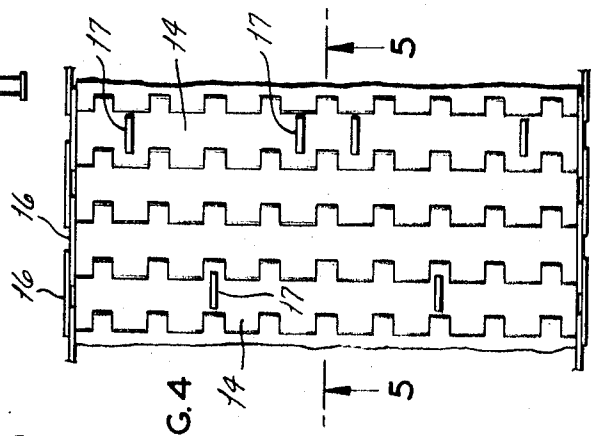


FIG. 4

INVENTOR

JAMES L. TORRENCE

BY Gravely, Lieder & Woodruff

ATTORNEYS

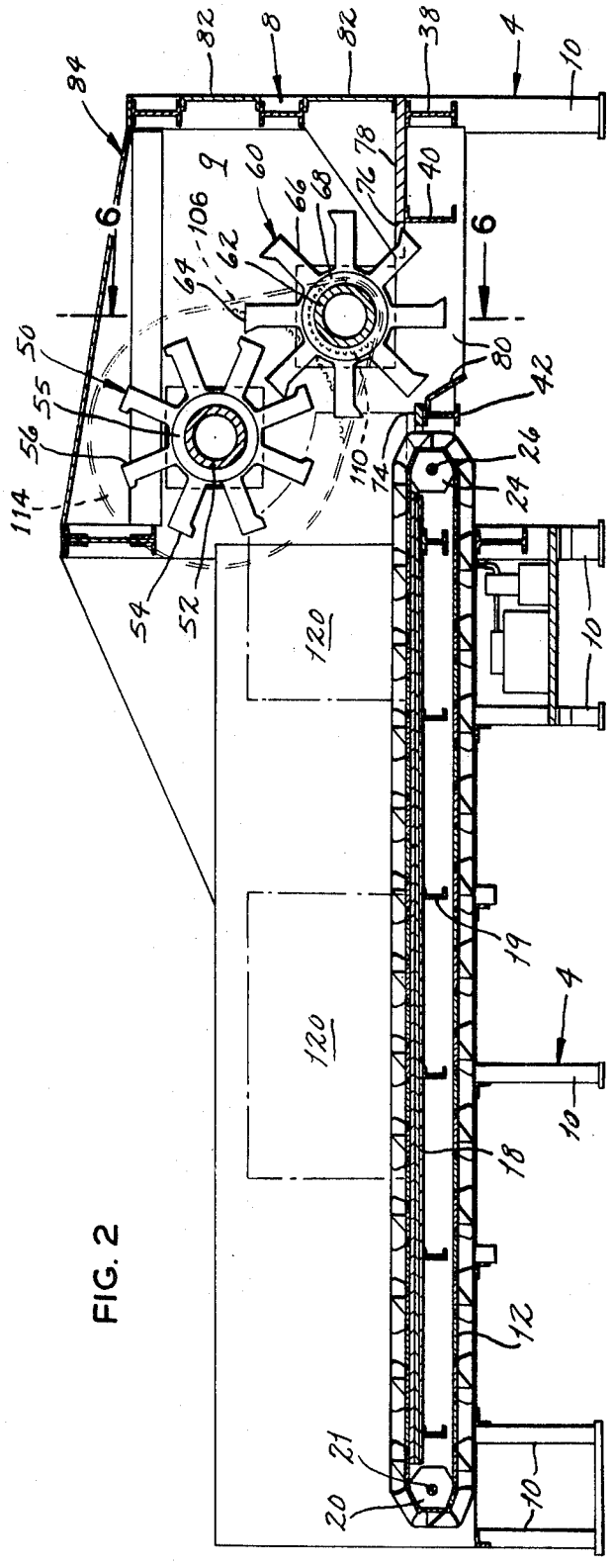


FIG. 2

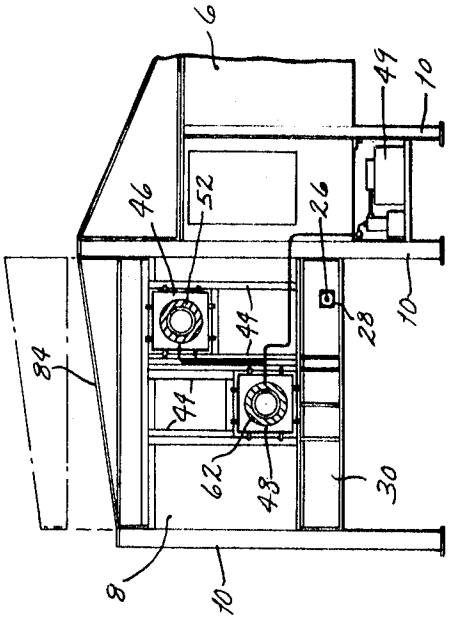


FIG. 3

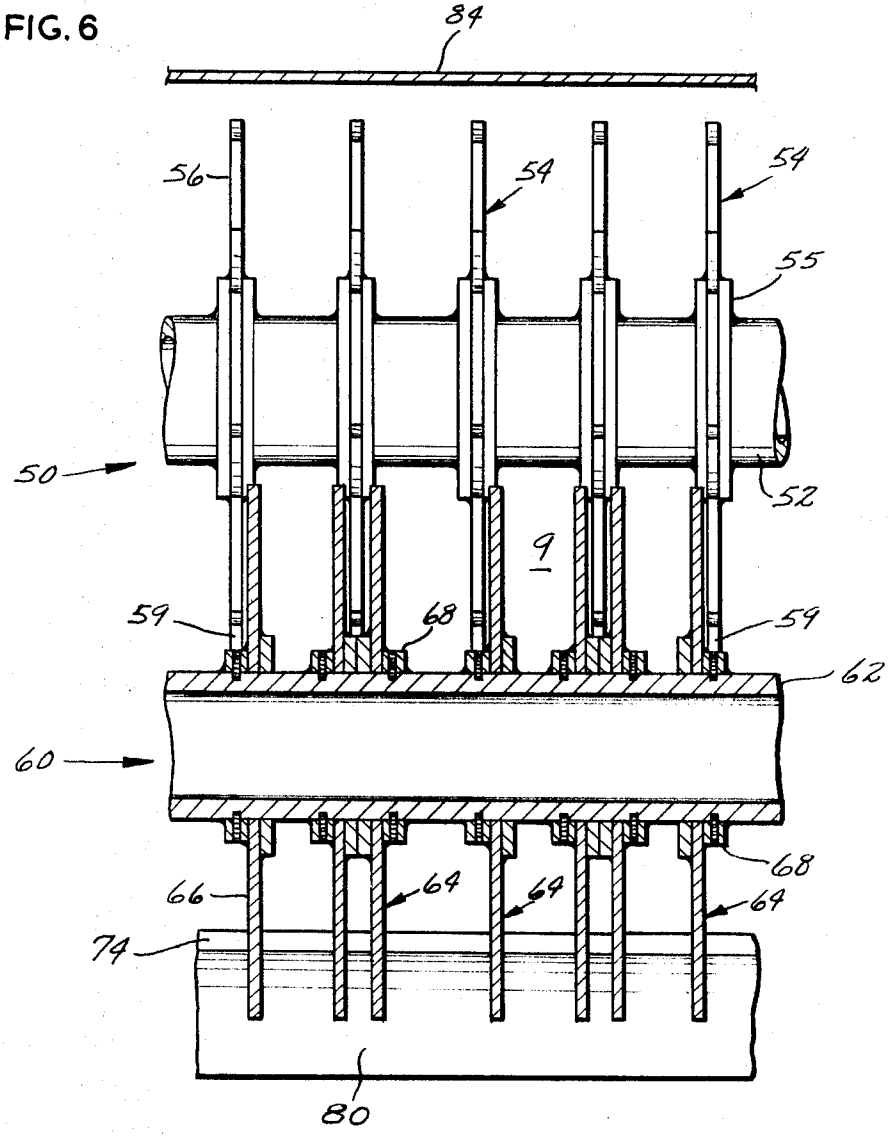
INVENTOR

JAMES L. TORRENCE

BY Gravely, Lieder & Woodruff

ATTORNEYS

FIG. 6



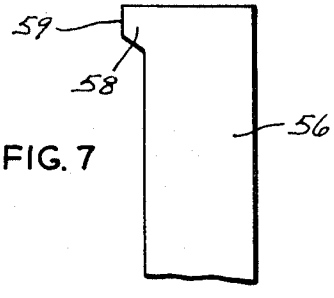


FIG. 7

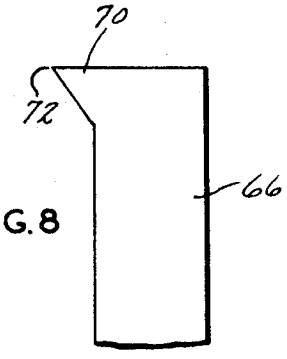


FIG. 8

INVENTOR
JAMES L. TORRENCE
BY Gravely, Lieder & Woodruff
ATTORNEYS

REDUCTION MILL

This invention relates to machines for reducing material.

The disposition of scrap and refuse material has become a major problem in recent years, and it is generally agreed that such material is more easily disposed of when reduced to a small particle size. For example, sheet metal scrap resulting from stamping operations is often bound into bales and shipped to smelters where it is converted into basic metal products again. By reason of the great bulk of such bales, transportation costs are high and, accordingly, this method of disposition for sheet metal scrap has marginal economic value. To reduce the transportation costs the bales are often broken apart at a central location, and the scrap metal is then introduced into a shredding device such as a hammermill to reduce it to a size which is more economical to transport. The shredded metal is then discharged into a rail car or truck for shipment to a smelter. While this procedure is, from an economic standpoint, more desirable than shipping bales directly, the bales are often tightly compressed and are, therefore, difficult to break apart for introduction into shredding machines. Moreover, on many occasions the individual pieces of scrap metal are too large and clog up the shredding machines.

Municipal refuse, on the other hand, often contains large items such as old furniture, crates, boxes, tree limbs and the like, which are not only difficult to handle, but also by reason of their bulk, consume enormous amounts of landfill. Moreover, the land filled by such items is often unstable for many years and, therefore, cannot be used to provide sufficient support for buildings and other structures. Similarly, where the refuse is burned, it is desirable to reduce its size in order to achieve more complete combustion and to hasten the incineration process.

One of the principal objects of the present invention is to provide a reduction mill for reducing bulky material to a size more convenient for transporting or subsequent disposition. Another object is to provide a reduction mill to prepare bales of scrap metal for further reduction in hammermills and similar shredding devices. A further object is to provide a mill capable of reducing refuse material to a size suitable for incineration or for use as a landfill. Still another object is to provide a reduction mill of the type stated which is economical to manufacture and operate, and is rugged and durable in construction. These and other objects and advantages will become apparent hereinafter.

The present invention is embodied in a reduction mill having a conveyor which discharges material into a reduction chamber in which a feed roll and a shredding roll revolve. The feed roll rotates above the discharge end of the conveyor, whereas the shredding roll is located generally beyond the discharge end.

The invention also consists in the parts and in the arrangement and combination of parts hereinafter described and claimed in the accompanying drawings which form a part of the specifications and wherein like numerals and letters refer to like parts wherever they occur:

FIG. 1 is a side elevational view of a reduction mill constructed in accordance with and embodying the present invention,

FIG. 2 is a longitudinal sectional view of the reduction mill,

FIG. 3 is a fragmentary elevational view of the opposite side of the reduction mill with the feed and shredding shafts in section,

FIG. 4 is a fragmentary plan view of a conveyor forming part of the reduction mill,

FIG. 5 is a sectional view taken along line 5–5 of FIG. 4,

FIG. 6 is a sectional view taken along line 6–6 of FIG. 2,

FIG. 7 is a fragmentary elevational view of a radial arm on the feed roll, and

FIG. 8 is a fragmentary elevational view of a radial arm on the shredding roll.

Referring now in detail to the drawings, 2 designates a reduction mill including a framework 4 which supports a conveyor cage 6 and a reduction cage 8, the latter enclosing a reduction chamber 9 into which the former opens. The framework 4 further consists of pairs of upstanding support members 10 which are secured to a floor or some other supporting surface. The base of the conveyor cage 6 is defined by the upper run of an endless hinged conveyor 12 consisting of a plurality of links 14 (FIGS. 4 and 5) which are notched at their leading and trailing ends and fitted together by transversely extending pins 15. The links 14 extend approximately the entire width of the conveyor cage 6 and at the side of the conveyor cage 6 they are provided with upstanding and overlapping side plates 16. Intermediate their side plates 16, some of the links 14 are provided with outwardly projecting triangular lugs 17 mounted such that one of the apices points outwardly. The links 14 forming the upper run or pass the endless conveyor 12 pass over and are supported by underlying ways 18 which extend longitudinally in the cage 6 and are in turn supported on cross channels 19 forming part of the frame 4. At its outer end the endless conveyor 12 is trained over an idler sprocket 20 on the shaft 21 which is journaled in longitudinally adjustable pillow blocks 22 carried by the two endmost pairs of upstanding members 10. At its opposite end the conveyor 12 is trained over a drive sprocket 24 on a conveyor drive shaft 26 which is journaled in a pair of bearings 28 mounted on longitudinally extending side channels 30 forming the base of the reduction cage 6. The drive shaft 26 and, in turn, the conveyor 12, are driven by a conveyor motor 32 which is connected to the drive shaft 26 through a chain 34 and a sprocket 36 keyed to the shaft 26.

In addition to the two endmost pairs of upstanding members 10 and the side channels 30 interconnecting them, the framework 4 at the reduction cage 8 further includes an end crossbeam 38 (FIG. 2) extending between the side channels 30 at the endmost pair of upstanding members 10, a cross channel 40 connected to the side channels 30 and set inwardly from the crossbeam 38, and an I-beam 42, also interconnecting the side channels 30 and located immediately beyond the inner end of the conveyor 12. Intermediate the two endmost sets of upstanding members 10 at the reduction cage 8, a plurality of opposed vertical frame members 44 (FIG. 3) are welded to and project upwardly from the side channels 30, and bolted to the frame members 44 are two pairs of aligned bearings 46 and 48 which are lubricated by an automatic lubrication system 49 on the framework 4.

The bearings 46 are located directly above that portion of the conveyor 12 which is trained over the sprocket 24, and they carry a feed roll 50 which rotates in upwardly spaced relation to the inner end of the conveyor 12. The feed roll 50 includes a feed roll shaft 52 journaled in the bearings 46 and a plurality of axially spaced feed wheels 54 secured to the shaft 52. The feed wheels 54 have hubs 55 welded to the shaft 52, and projecting beyond the hubs 55 are radial feed arms 56 which terminate at circumferentially extending projections 58 pointing in the direction of rotation for the roll 50. The projections 58 have blunt leading edges 59 (FIG. 7).

The bearings 48, on the other hand, are set further inwardly and below the bearings 46, and they carry a shredding roll 60. The bearings 48, however, are still located above the surface on the upper run of the conveyor 12 so that the major portion of the roll 60 is disposed above and inwardly beyond that portion of the conveyor 12 which is trained over the sprocket 24. The shredding roll 60 includes a shredding roll shaft 62 journaled in the bearings 48, and a plurality of axially spaced shredding wheels 64 having radial shredder arms 66 and hubs 68, the latter of which are pinned to the shaft 62 such that the arms 66 of the wheels 64 will pass intermediate and in close proximity to the radial arms 56 of the feed roll 50 as illustrated in FIG. 6. The radial arms 66, furthermore, terminate at integrally formed chisel points 70 which project circumferentially in the direction of rotation for the wheel 64 and have relatively sharp cutting edges 72 (FIG. 8).

As the shredding roll 60 rotates, its chisel points 70 pass in close proximity to a cutting bar 74 secured to the upper flange of the I-beam 42 located immediately beyond the inner end of the conveyor chain 12. They also pass intermediate the furcations 76 of a comb plate 78 which is fastened to the upper flanges of the cross channel 40 and end crossbeam 38. The I-beam 42 and the cross channel 40 carry a downwardly extending discharge chute 80 through which the lower segment of the roll 60 revolves.

The end wall of the reduction cage 8 is provided with access doors 82 for inspection and cleaning of the comb plate 78, and the rolls 50 and 60. The top of the reduction cage 8 is closed by means of a removable cover 84, which not only prevents debris from escaping through the top, but also rigidifies the entire framework 4.

The feed roll 50 and the shredding roll 60 are driven at a predetermined speed ratio through a drive train 90 (FIG. 1) including a conventional electric motor 92 which is connected to the input shaft of a gear box 94 through a V-belt drive 96. The output shaft of the gear box 94 is fitted with a sprocket 98 over which a chain 100 is trained, the chain 100 also being trained over the large diameter idler sprocket 102 which is journaled for free rotation on one end of the feed roll shaft 52. Attached to the face of the large diameter idler sprocket 102 is a small diameter idler sprocket 104 which drives the shredding roll 60 through a chain 106 and a somewhat larger sprocket 108 on one end of the shredding roll shaft 62. The shredding roll shaft 62 is also fitted at both of its ends with smaller sprockets 110 over which chains 112 are trained, the opposite ends of the chains 112 being trained over larger drive sprockets 114 keyed to the feed roll shaft 52. Of course, the respective diameters of the sprockets 110 and 114 will determine the speed ratio between the shredding roll 50 and the feed roll 60, and a speed ratio of 4 to 1 has been found suitable for the reduction of most materials. Moreover, the conveyor motor 32 should propel the conveyor chain 12 at a velocity which is substantially equal to the peripheral velocity of the radial arms 56 on the feed roll 50. In other words, the linear velocity of the projections 58 at any instant should be about the same as the chain 12. To this end, both motors 32 and 92 are provided with conventional speed control devices (not shown).

In operation, material to be reduced is placed on the conveyor chain 12 at the inlet end of the conveyor cage 6. For convenience of illustration this material will be referred to as a bale 120 of sheet metal scrap although it should be understood that reduction mill 2 is capable of accepting many other kinds of scrap, such as bales of paper, wood products crates, boxes, municipal refuse, discarded furniture, and household appliances. As the bale 120 is lowered onto the conveyor 12, the outwardly projecting lugs 17 protrude into it and advance it through the conveyor cage 6. In time the revolving radial arms 56 of the feed roll 50 will engage the bale 120 and as the bale 120 continues to advance on the conveyor 12, the blunt projections 58 on the arms 56 will pass down through the bale 120 separating it into a plurality of transversely arranged segments. The arms 56 further force the bale 120 downwardly and during the final segment of their arcuate pass across the end of the conveyor 12 they assist the conveyor 12 in advancing the scrap material of the bale 120 into the rotating blades 66 of the shredding roll 60.

The chisel points 70 on the rapidly rotating arms 66 of the shredding roll 60 tear into the scrap and shred it into smaller segments as the scrap is forced across the cutting bar 74 by both the conveyor 12 and the arms 56 of the feed roll 50. The shredded scrap falls downwardly into the discharge chute 80, below which it can be withdrawn by a conveyor 124 (shown in phantom in FIG. 1) or any other suitable means for further shredding in a hammermill. Any scrap material which catches on the radial arm 66 will be dislodged by the furcations of the comb plate 78. Similarly, that scrap material which attaches to the arms 56 of the feed roll 50 will be removed by the faster rotating and closely spaced arms 66 of the shredding roll 60.

Access to the comb plate 78 and the wheels 54 and 64 on the feed roll 50 and shredding roll 60 can be obtained through the access doors 82 in the reduction cage 8. Furthermore, the entire feed roll 50 and shredding roll 60 can be removed for major repairs and overhauls merely by removing the top cover 84 and detaching the bearings 46 and 48 from the vertical frame members 44 which support them, in which case the bearings 46 and feed roll 50, as well as the bearings 48 and shredding roll 60, are removed as a unit.

This invention is intended to cover all changes and modifications of the example of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

What I claim is:

1. A reduction mill comprising: a cage defining a reduction chamber; an endless conveyor having an upper conveying pass which leads into and terminates within the reduction chamber; a feed roll journaled for rotation in the cage about an axis extending transverse to the direction of movement for the upper conveying pass, the feed roll being located generally above the terminal end of the upper conveying pass and having outwardly projecting feed arms which are mounted rigidly thereon and are arranged in axially and circumferentially spaced relation with respect to each other, the feed arms upon rotation of the feed roll describing a circular path, at least a portion of which is presented directly above the conveying pass; a shredding roll journaled for rotation in the cage about an axis parallel to the axis of rotation for the feed roll, the shredding roll being located directly beyond the end of the conveying pass and having outwardly projecting shredder arms which are rigidly mounted thereon and are arranged in axially and circumferentially spaced relation with respect to each other, the shredder arms being axially offset from the feed arms and upon rotation of the shredding roll describing a circular path which extends below the upper surface of the conveying pass on the conveyor; the paths described by the ends of the feed and shredder arms further overlapping generally above the end of conveying pass so that the feed arms of the feed roll pass in between the shredder arms of the shredding roll, and drive means for rotating the feed and shredding rolls in the same direction whereby at the area of overlap between the circular paths described by the feed and shredder arms the feed and shredder arms will move in opposite directions the drive means rotating the shredding roll at a greater angular velocity than the feed roll and rotating the feed roll in the direction which causes the ends of its feed arms to pass downwardly toward the upper surface of the conveying pass on the conveyor and thereafter pass above the conveying pass of the conveyor generally in the same direction as the direction of movement for that conveying pass, whereby the feed arms are forced into material on the conveyor while the material is still supported by the upper conveying pass and once engaged with the material further assist the conveyor in advancing the material into the revolving shredder arms.

2. A reduction mill according to claim 1 and further characterized by a rigid cutting bar in the cage intermediate the end of the conveyor and path described by the ends of the shredder arms on the rotating shredding roll.

3. A reduction mill according to claim 2 wherein the axis of the shredding roll is located higher than the discharge end of the conveyor and the arms on the shredding roll pass downwardly past the cutting bar.

4. A reduction mill according to claim 2 wherein the feed arms terminate at projections which project circumferentially in the direction of rotation for the feed roll and are provided with blunt leading edges.

5. A reduction mill according to claim 1 wherein the feed arms terminate at projections which project circumferentially in the direction of rotation for the feed roll and are provided with blunt leading edges.

6. A reduction mill according to claim 1 wherein the shredder arms terminate at chisellike points which project circumferentially in the direction of rotation for the shredding roll.

7. A reduction mill according to claim 1 wherein the conveyor comprises a multitude of links hinged together into an endless configuration having a generally horizontal upper run on which the material is conveyed to the reduction chamber, and wherein at least some of the links are provided with outwardly projecting lugs for engaging the material.

8. A reduction mill according to claim 1 and further characterized by a comb plate in the reduction cage and having furcations which project intermediate the arms on the shredding roll.

9. A reduction mill according to claim 1 wherein the velocity of the feed arms at the outer ends thereof is substantially equal to the velocity of the conveyor.

10. A reduction mill according to claim 1 wherein the velocity of the shredding roll at the outer ends of its shredder arms is greater than the velocity of the feed roll at the outer ends of its feed arms.

11. A reduction mill according to claim 10 wherein shredding and feed rolls have substantially the same diameter.