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(54) **APPARATUS FOR CIRCULATING COMMINUTED MATERIALS**

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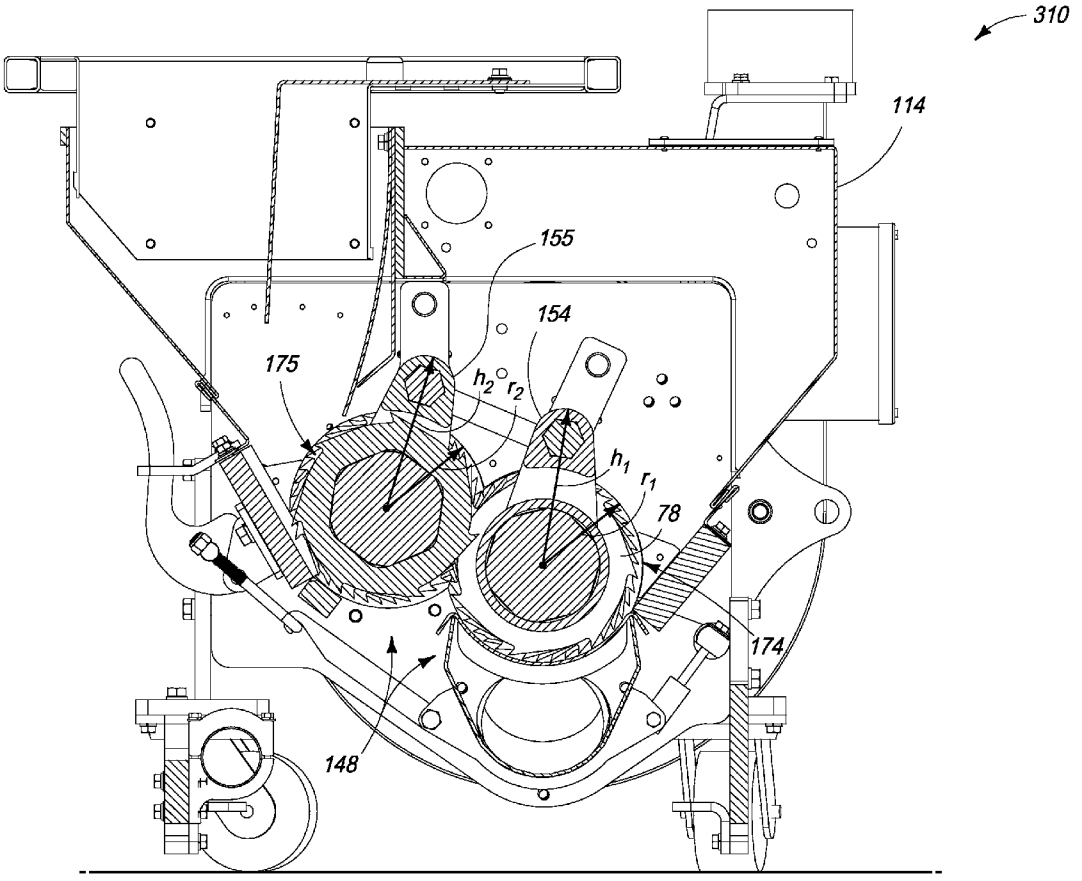
USPC **241/167**

(57) **ABSTRACT**

An improved scraper plate assembly is provided on a comminuting device having compliant rounded edges, sloped walls, and reduced height for placement along recycle flow paths within a comminuting apparatus when circulating subdivided waste material from between a pair of scissor rolls for further delivery to a scissor roll for further movement and subdividing of the subdivided waste material. A comminuting apparatus is also provided.



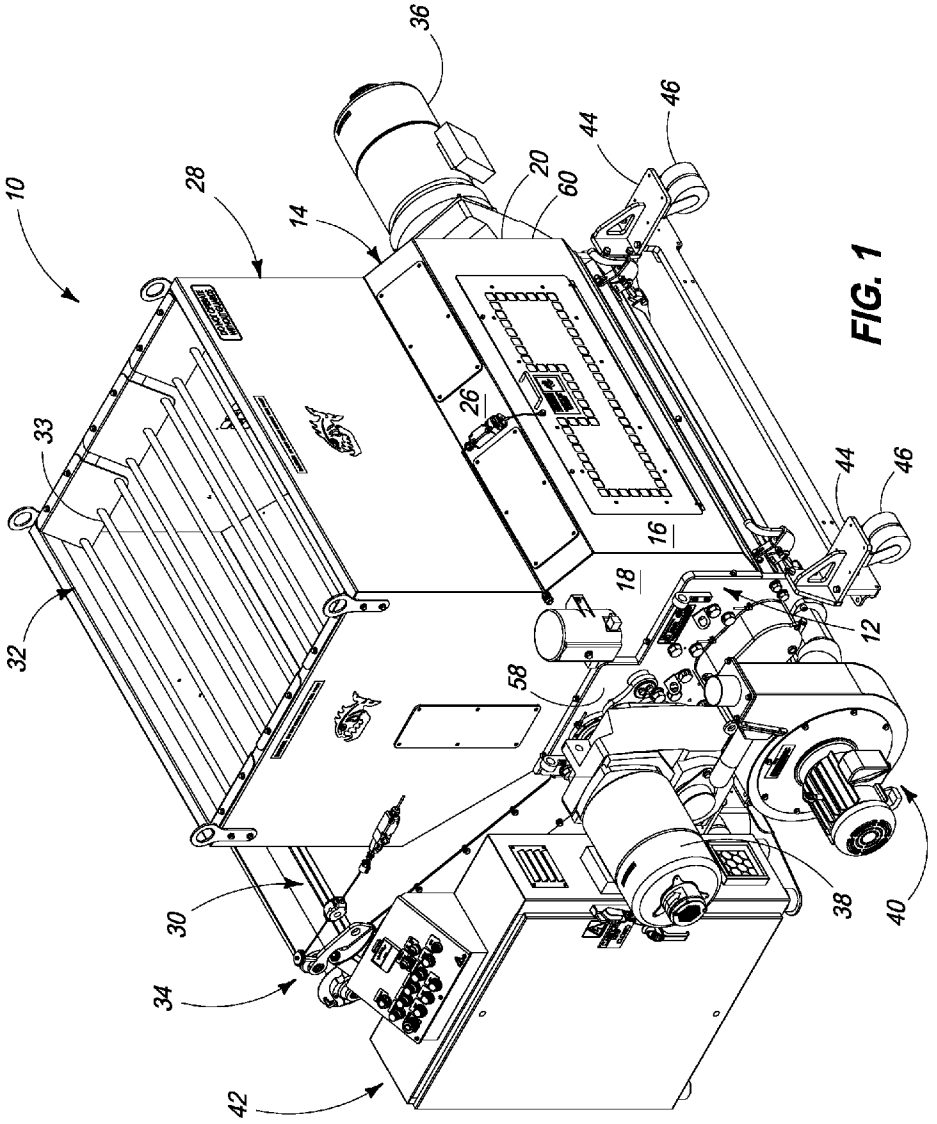


FIG. 1

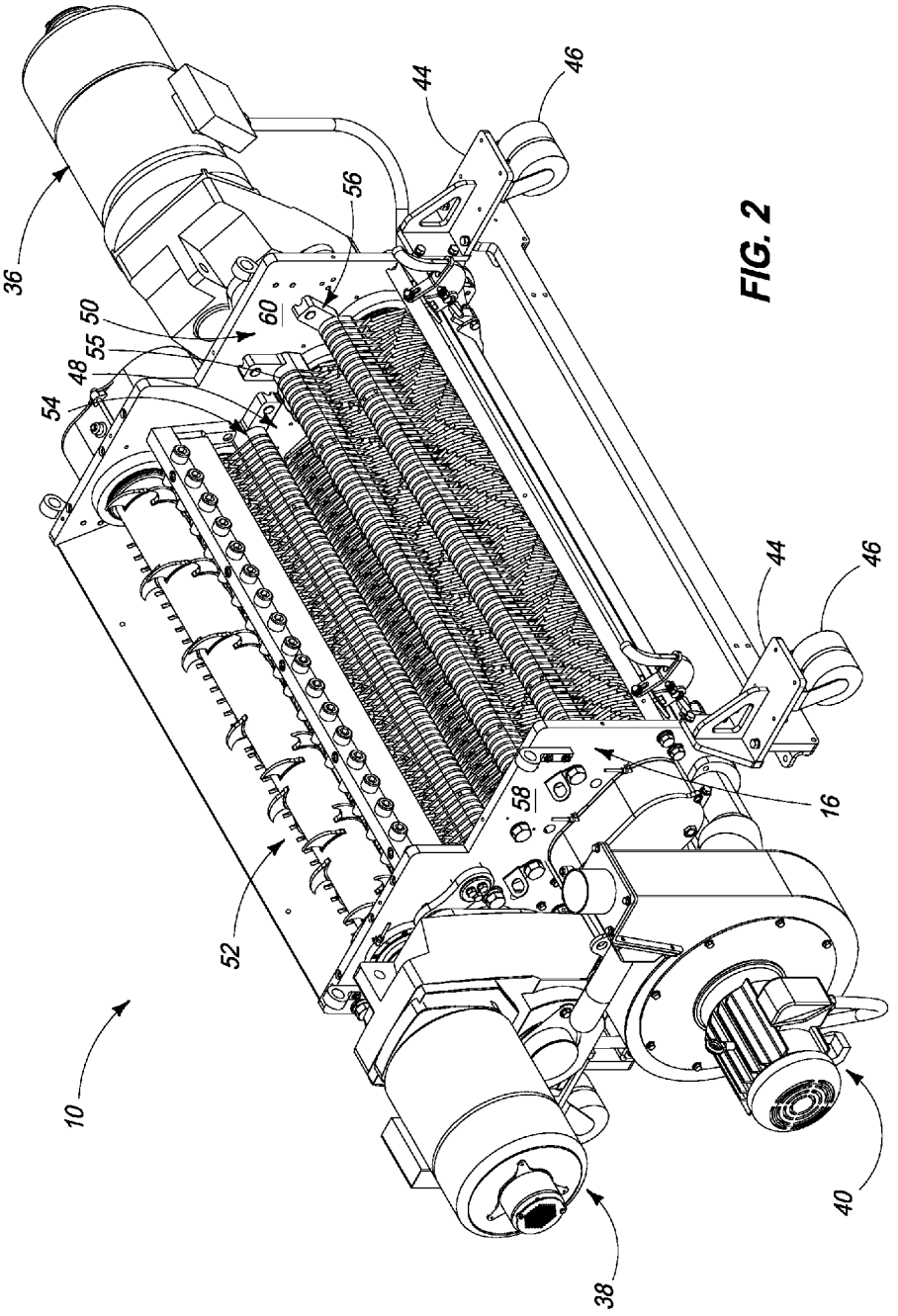


FIG. 2

FIG. 3

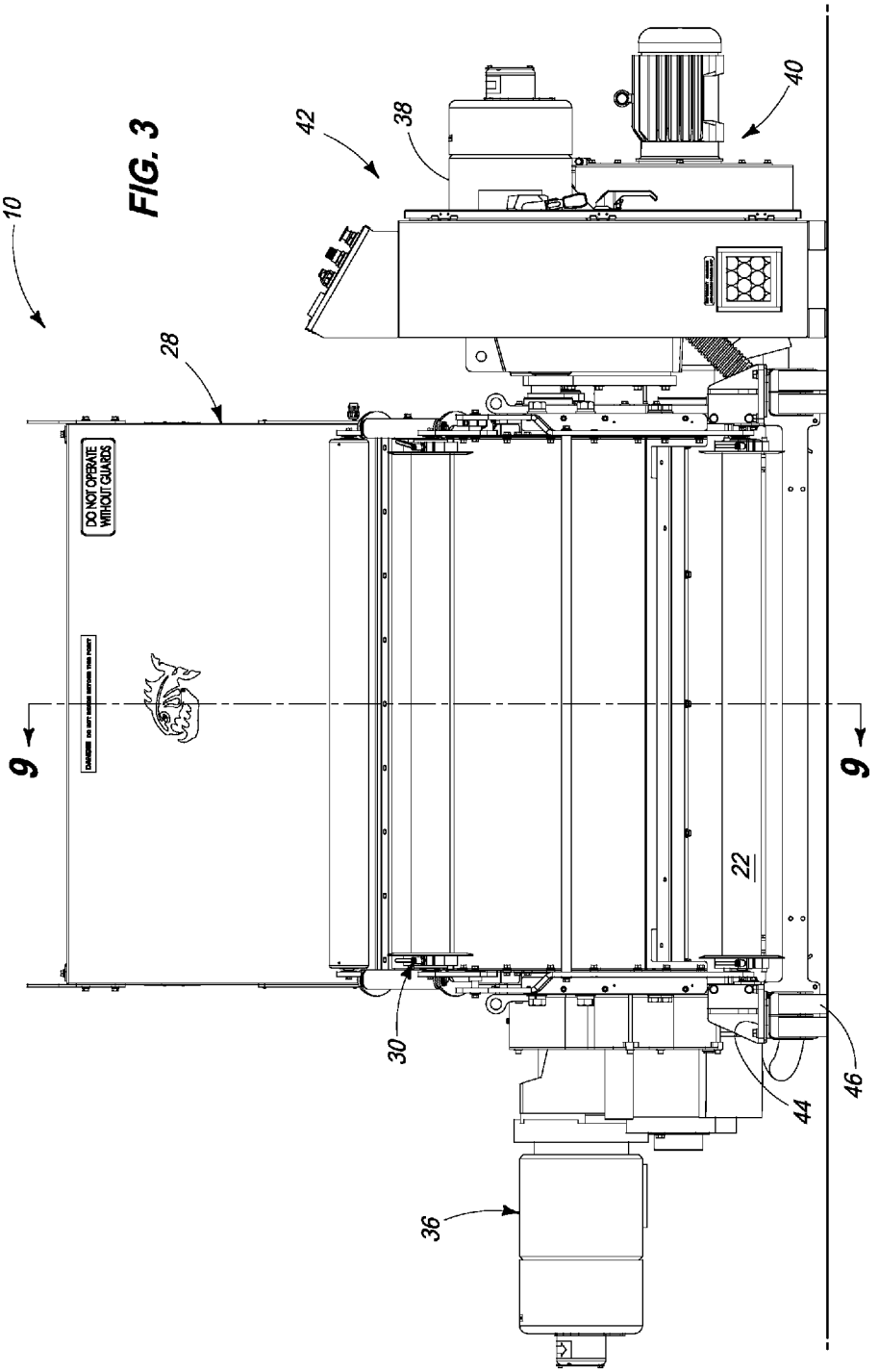


FIG. 4

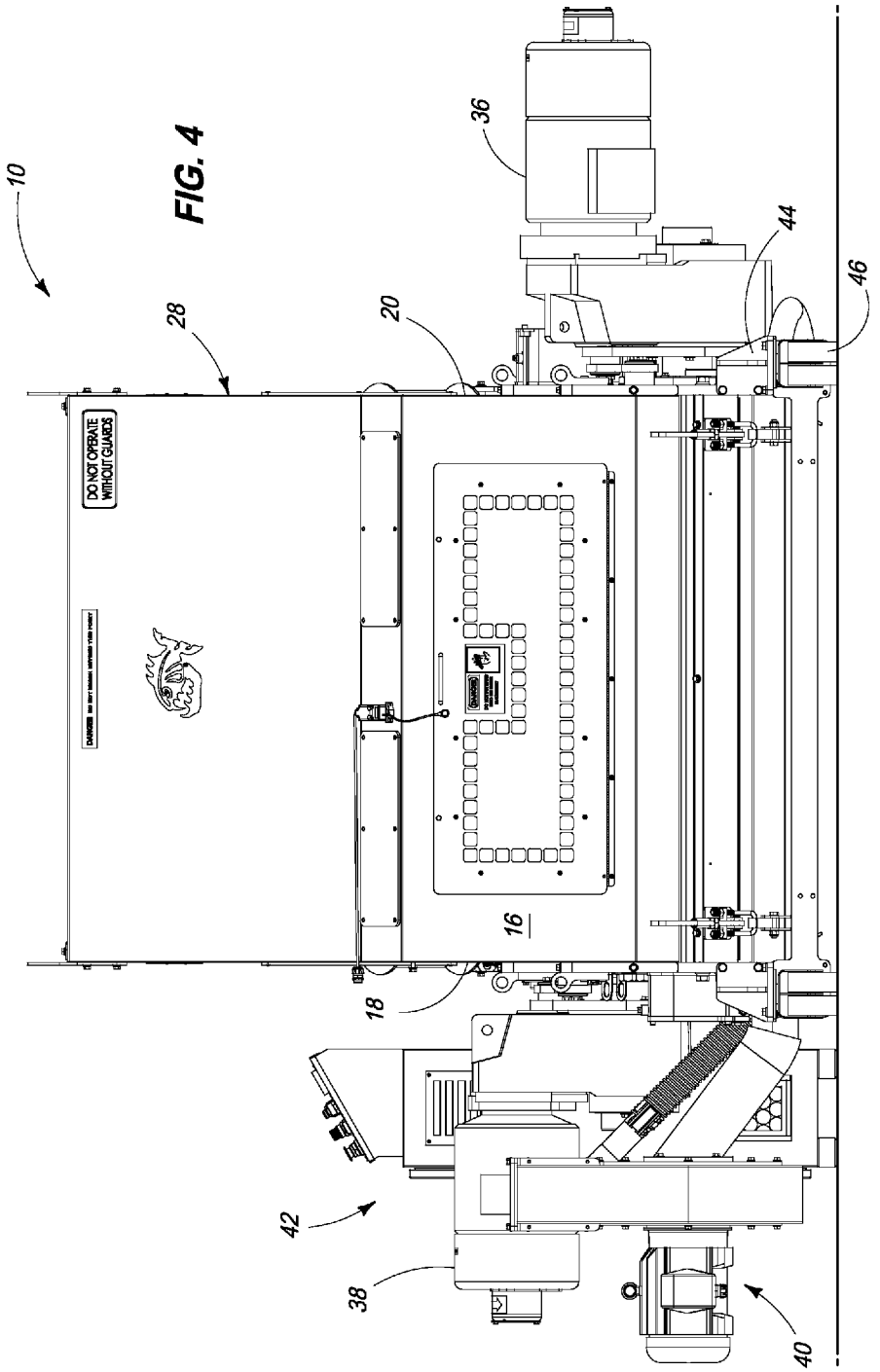


FIG. 5

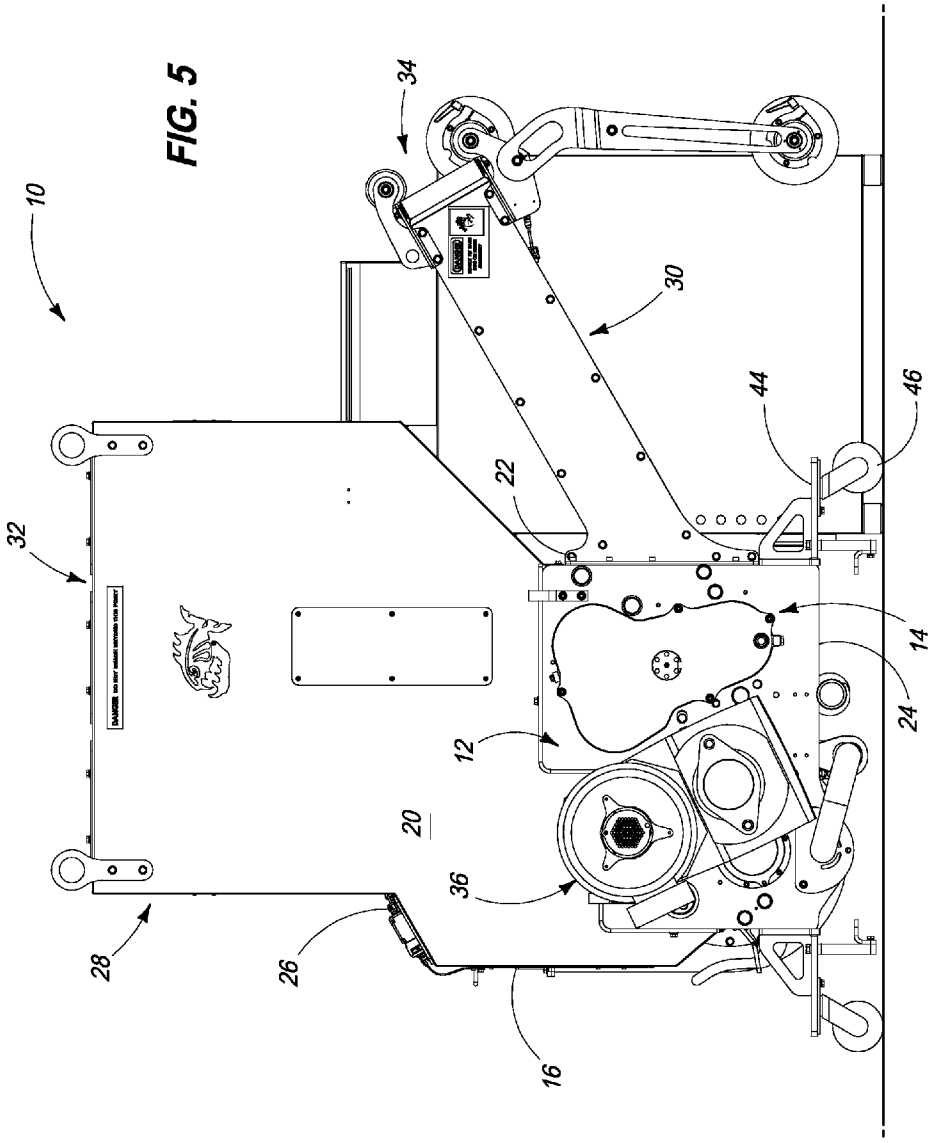


FIG. 6

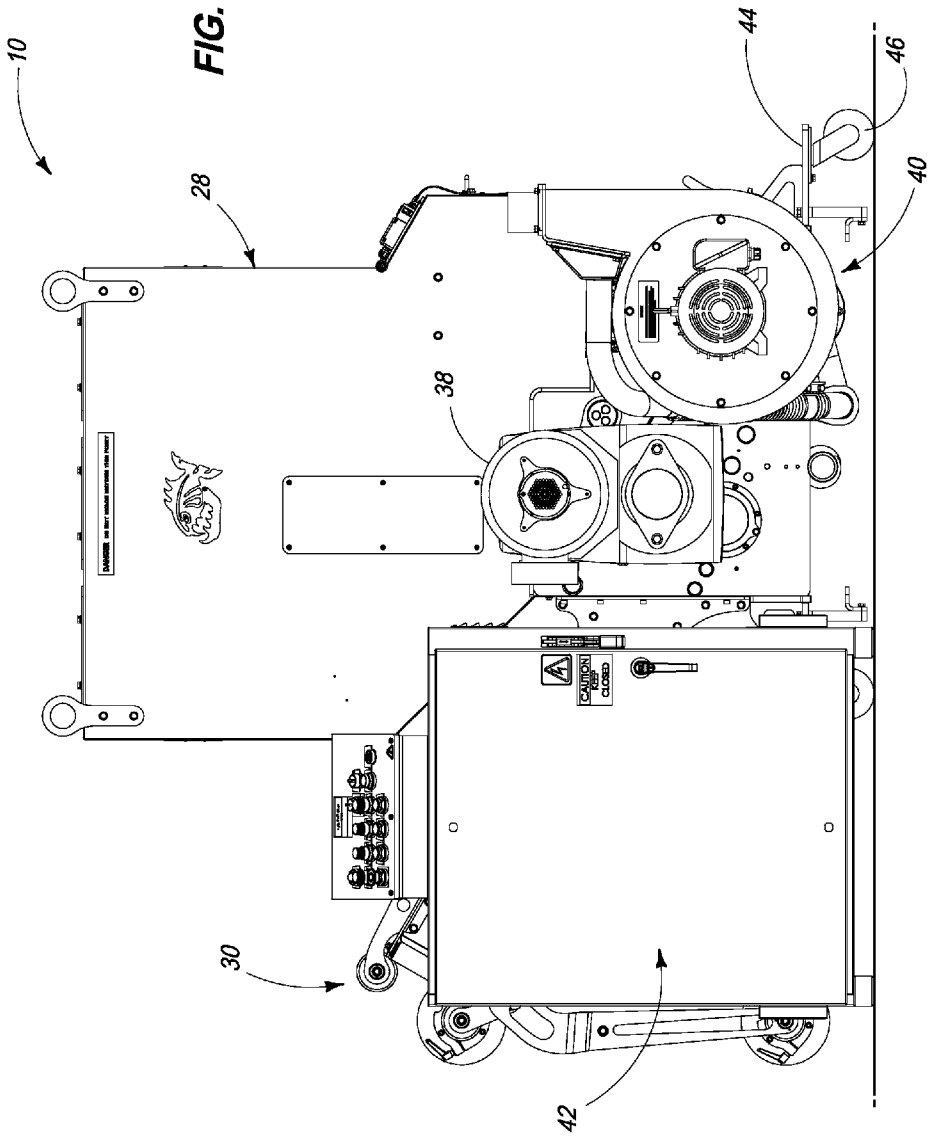
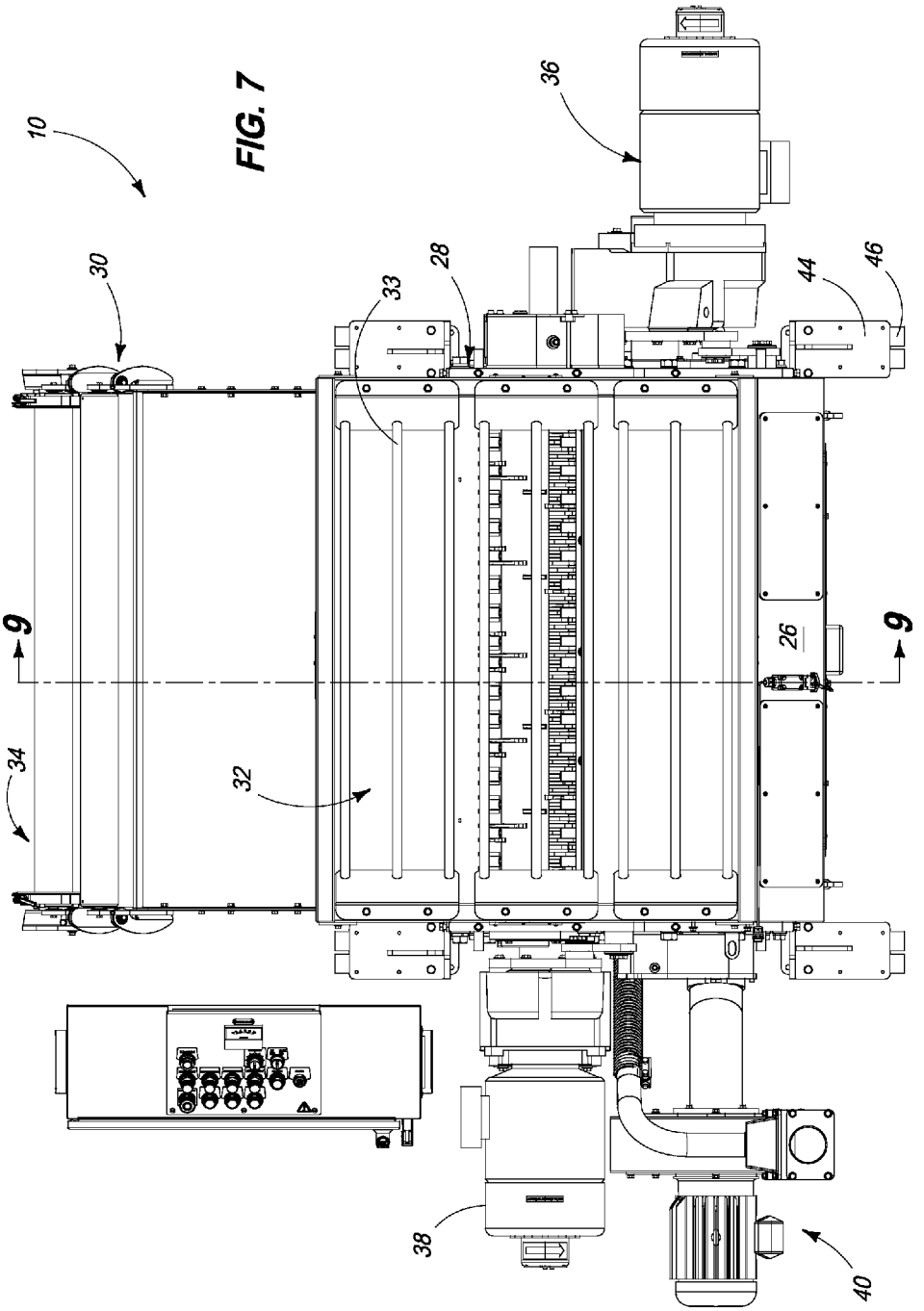


FIG. 7



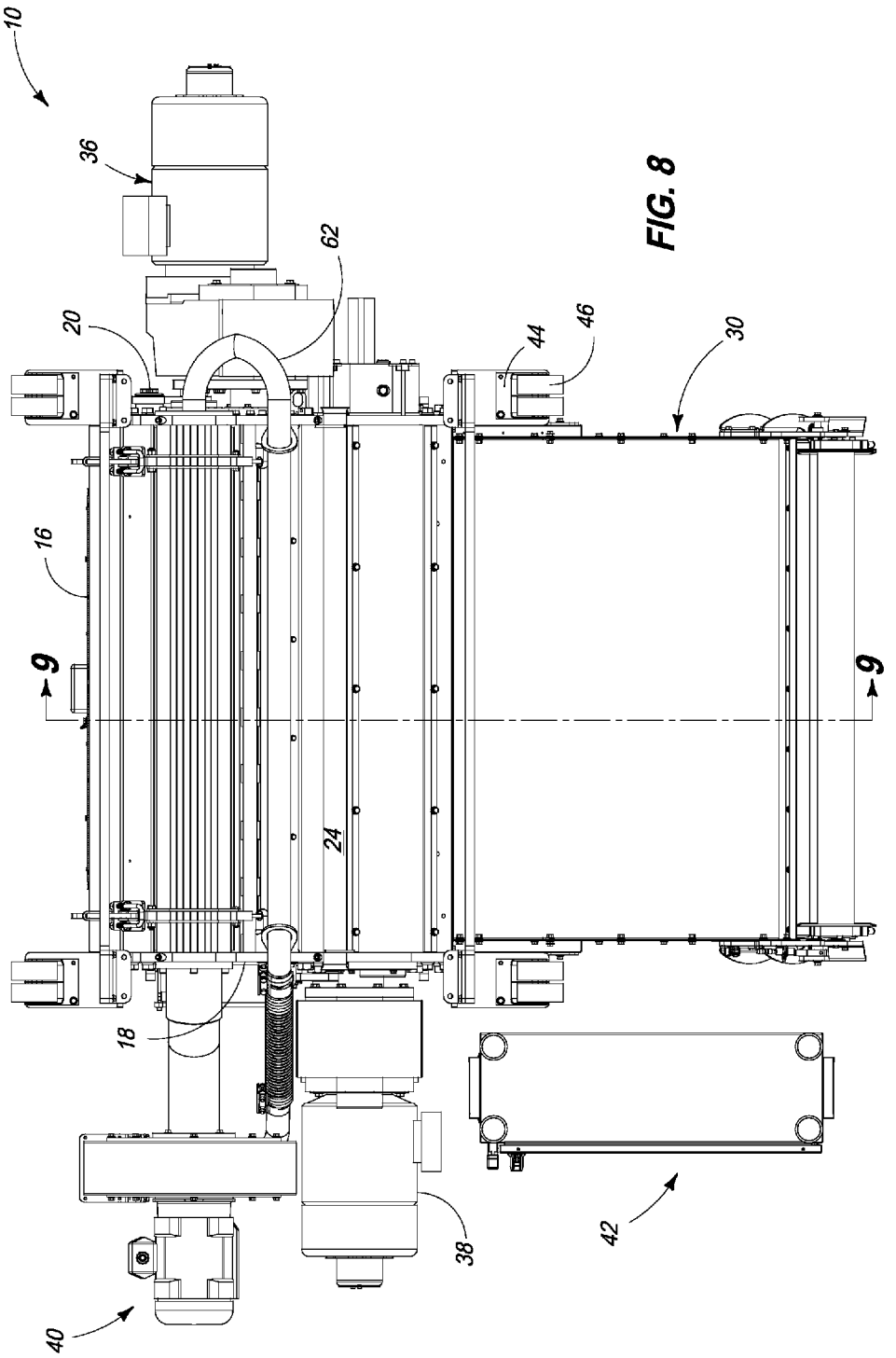


FIG. 8

FIG. 9

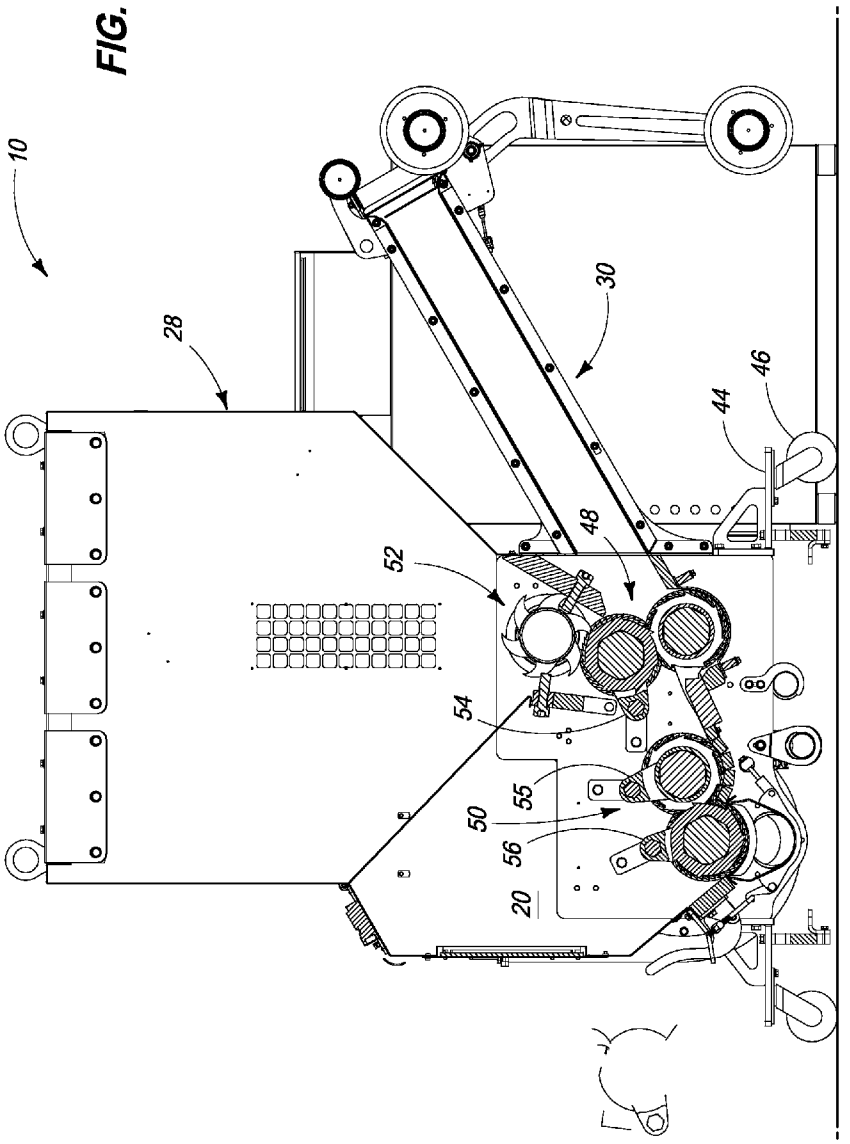


FIG. 10

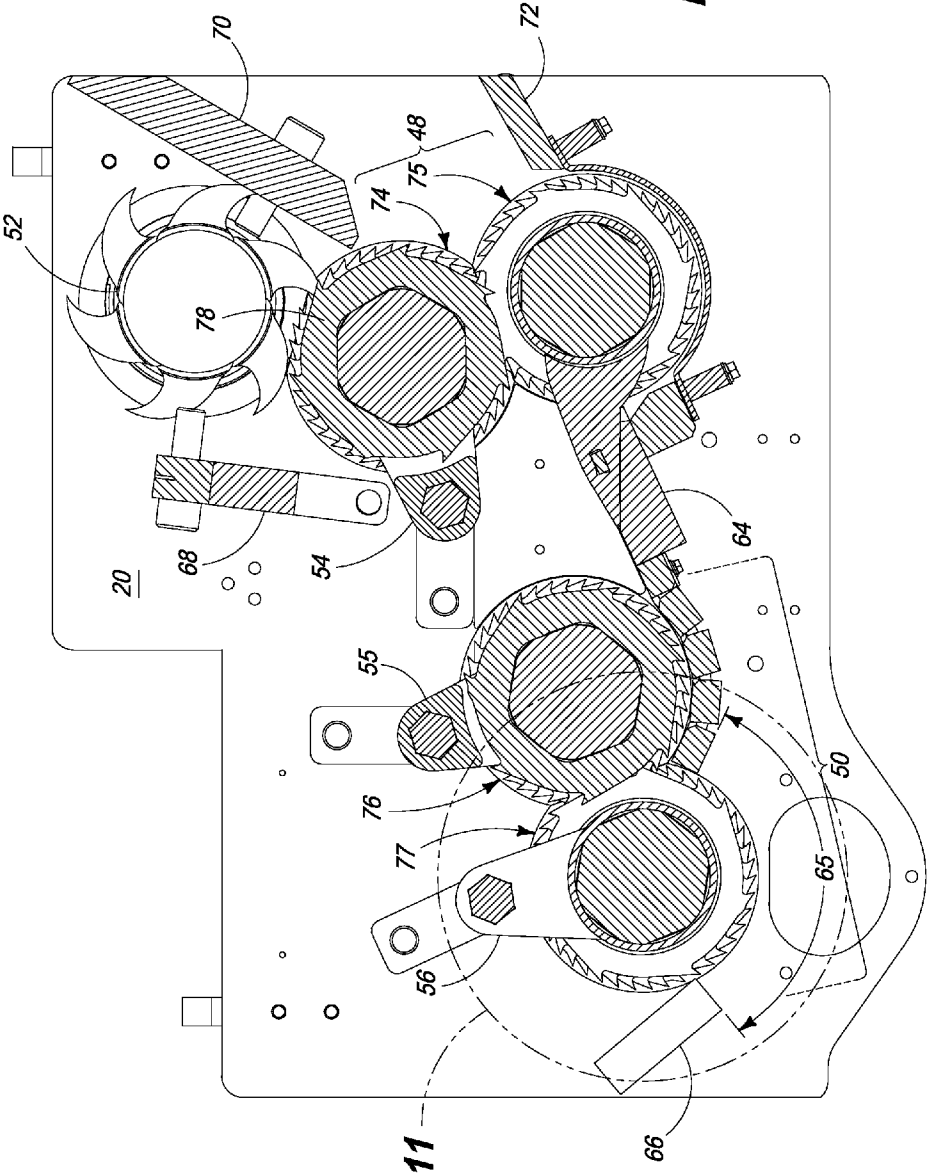
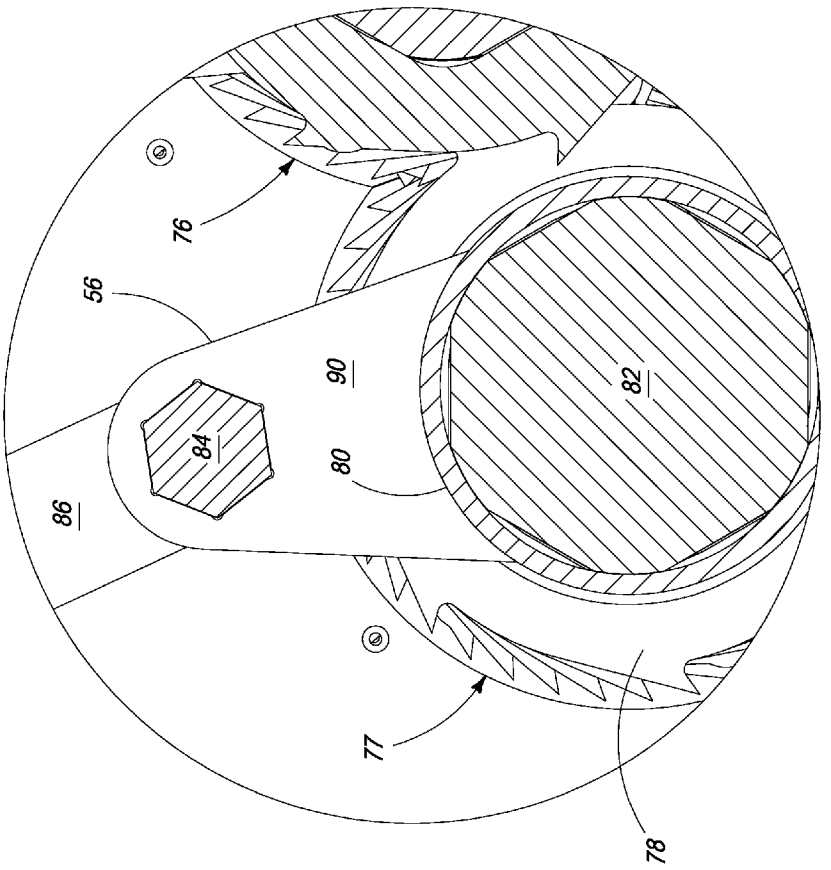


FIG. 11



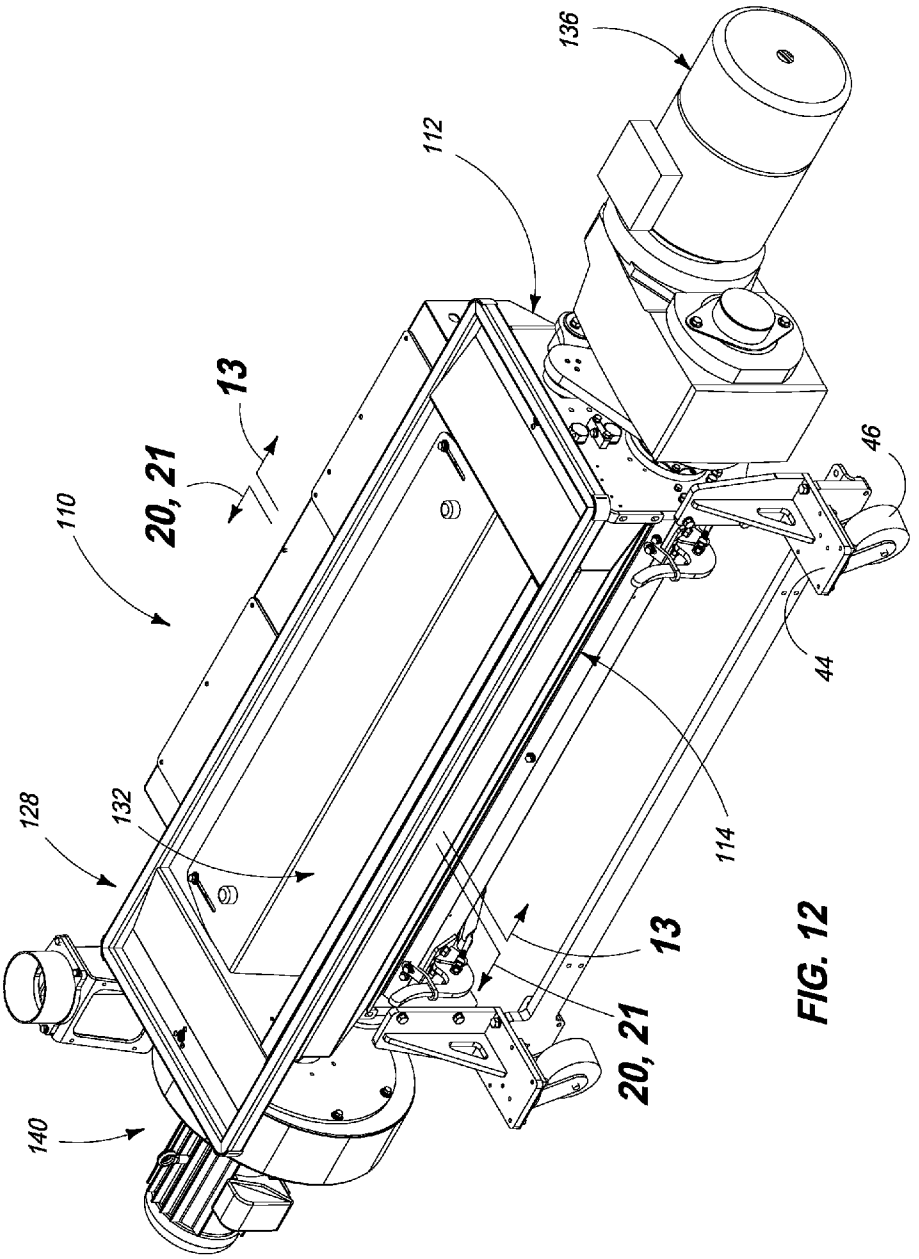
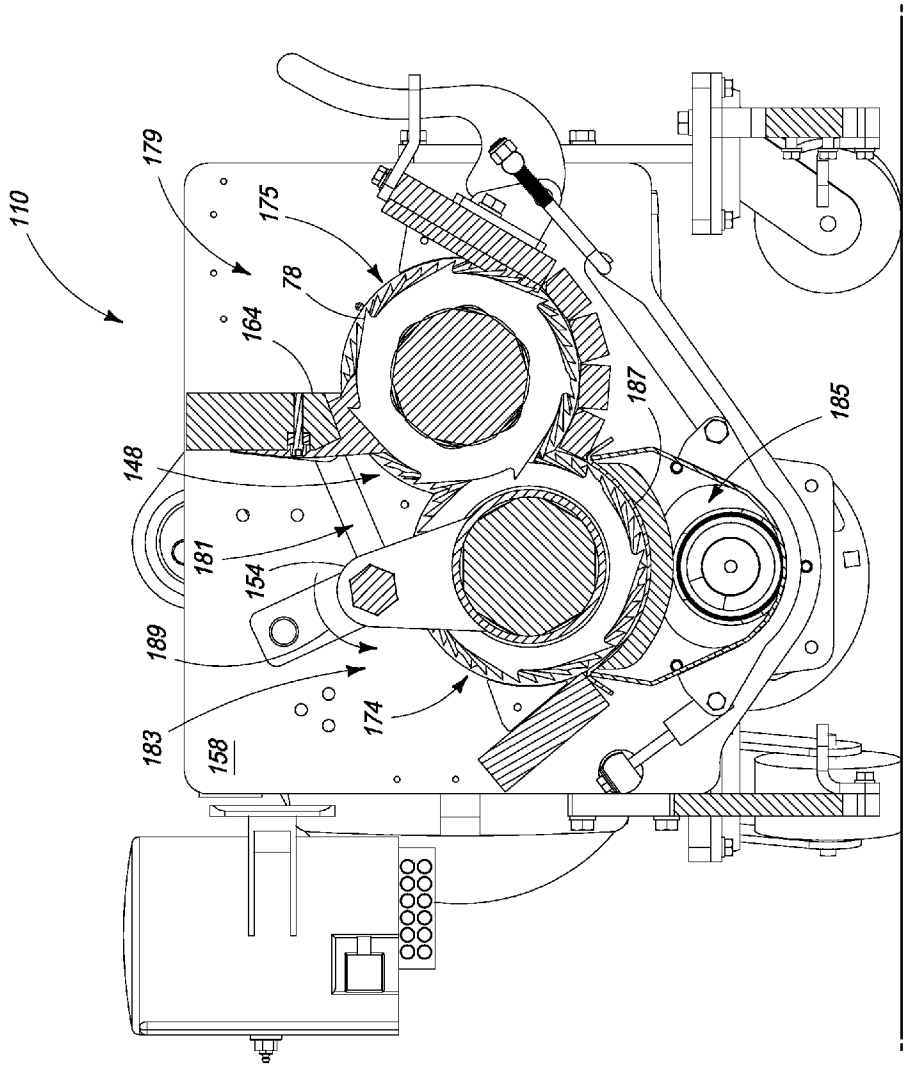


FIG. 12

FIG. 13



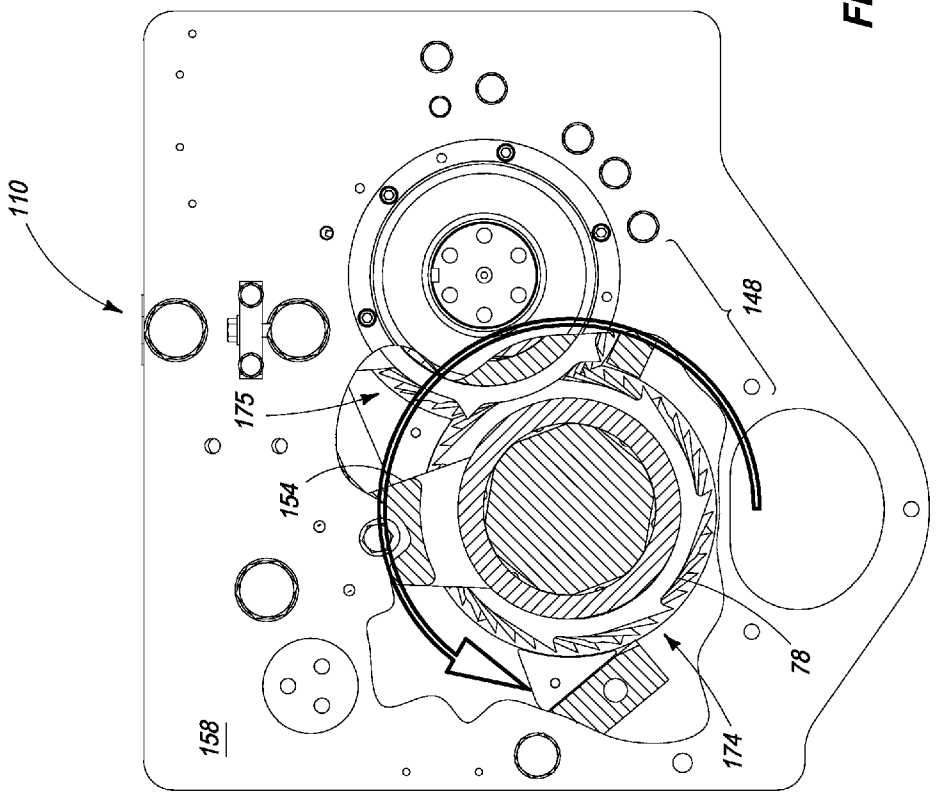


FIG. 14

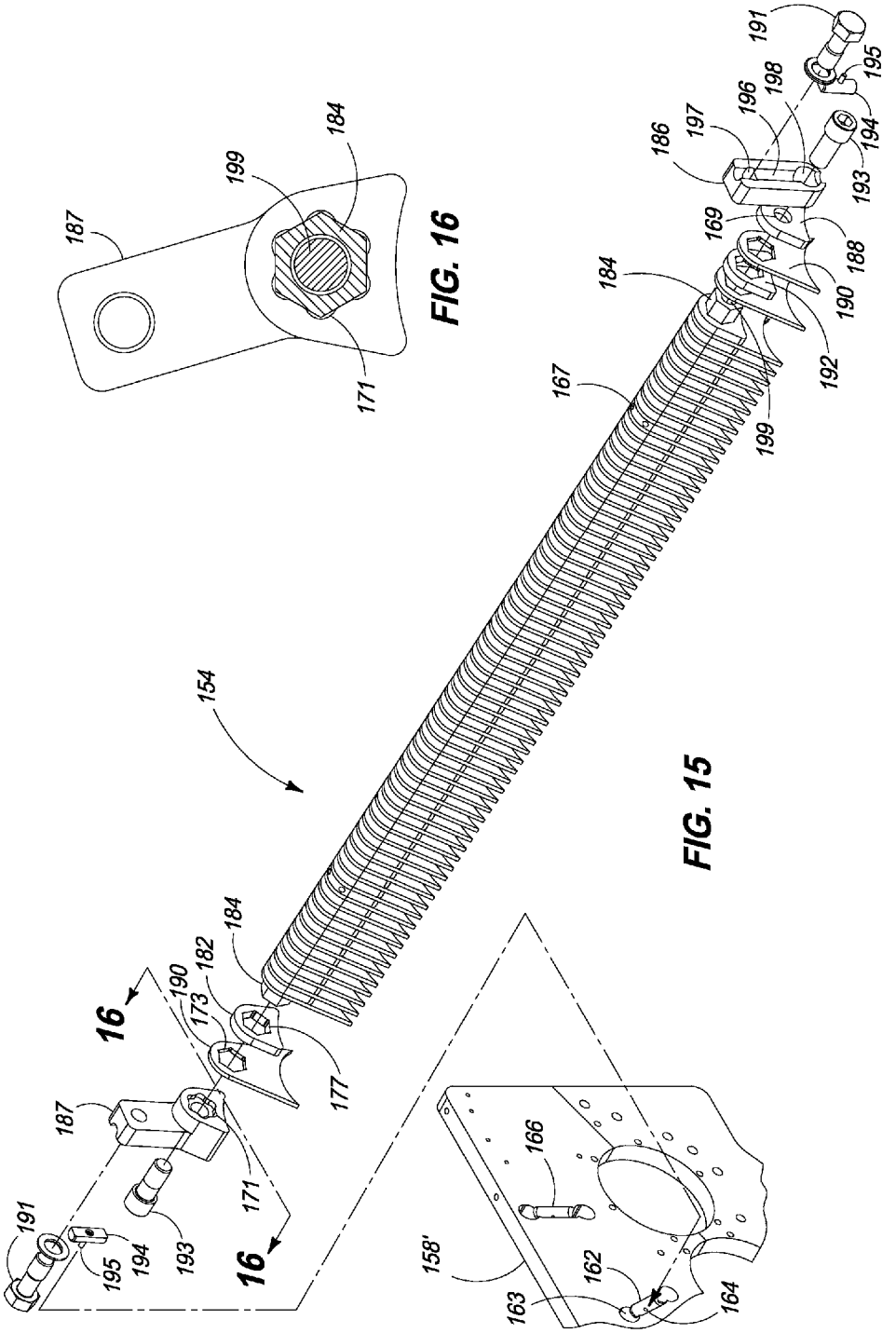

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FIG. 15

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FIG. 16

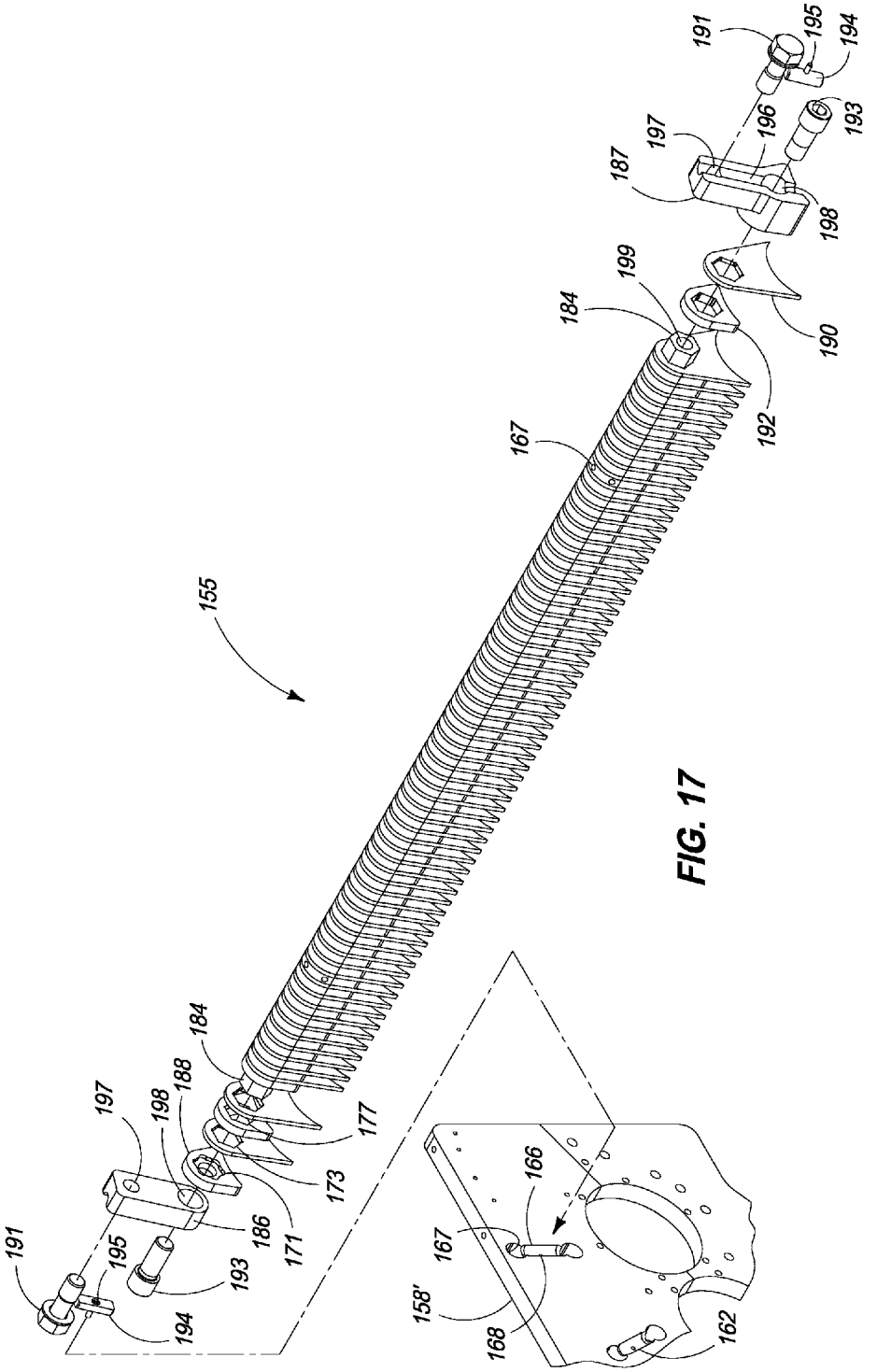
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FIG. 17

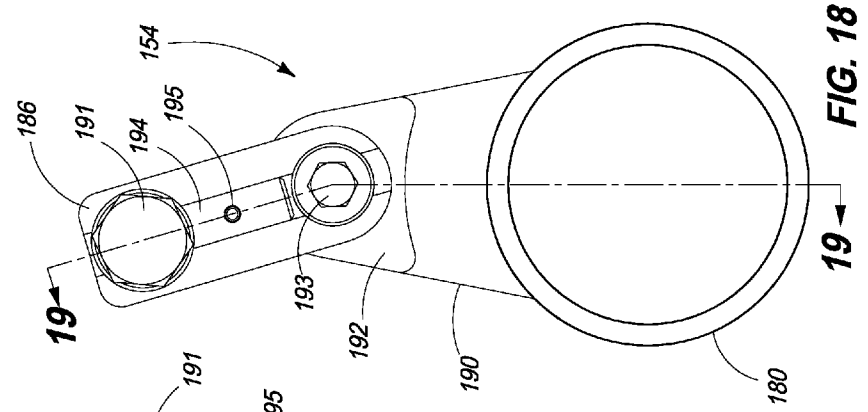
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FIG. 18

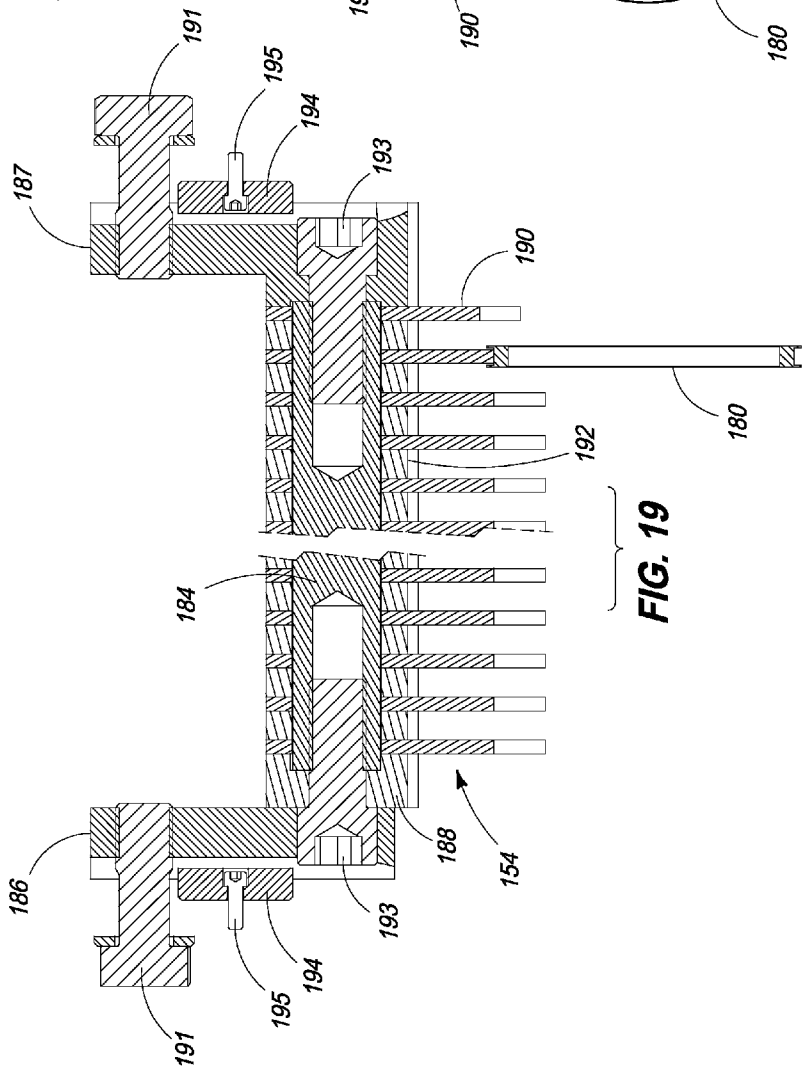
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FIG. 19

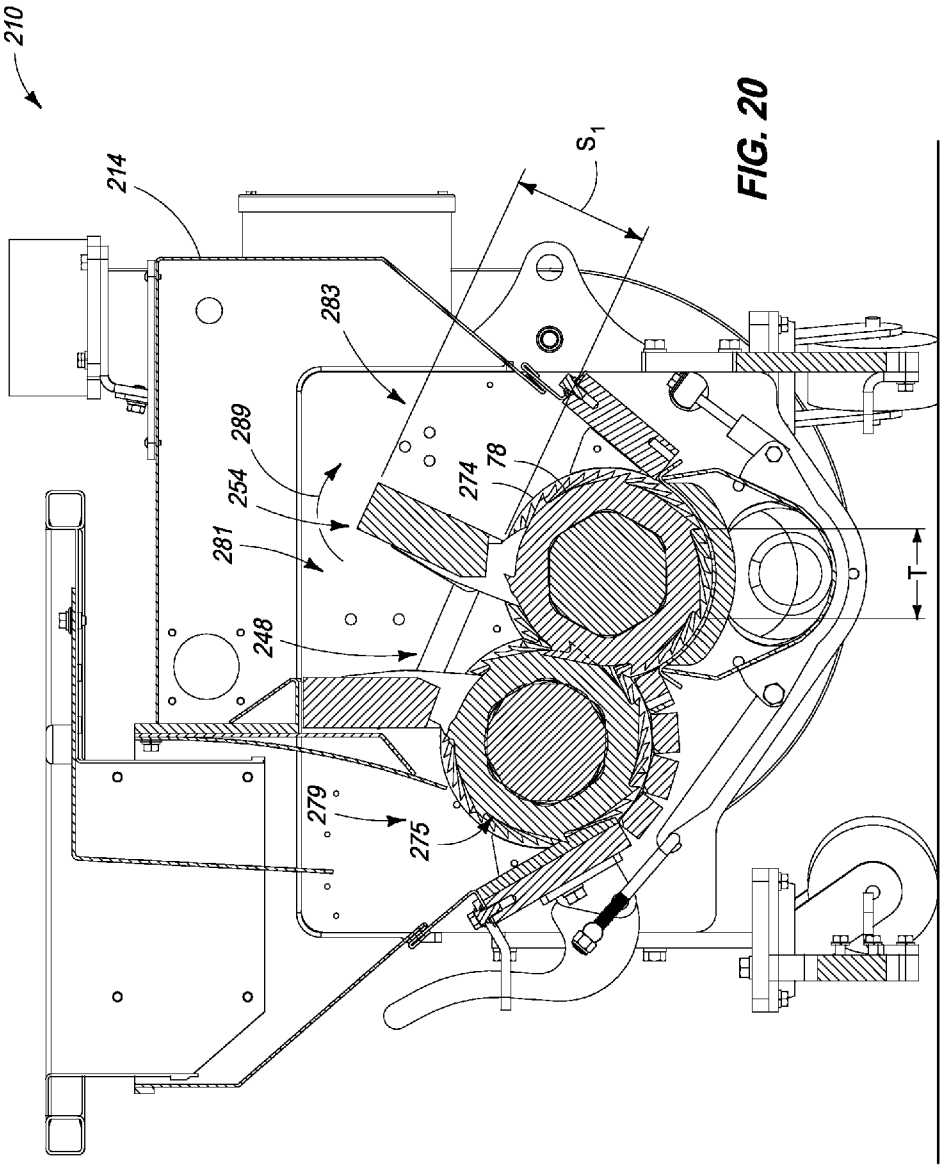

FIG. 20

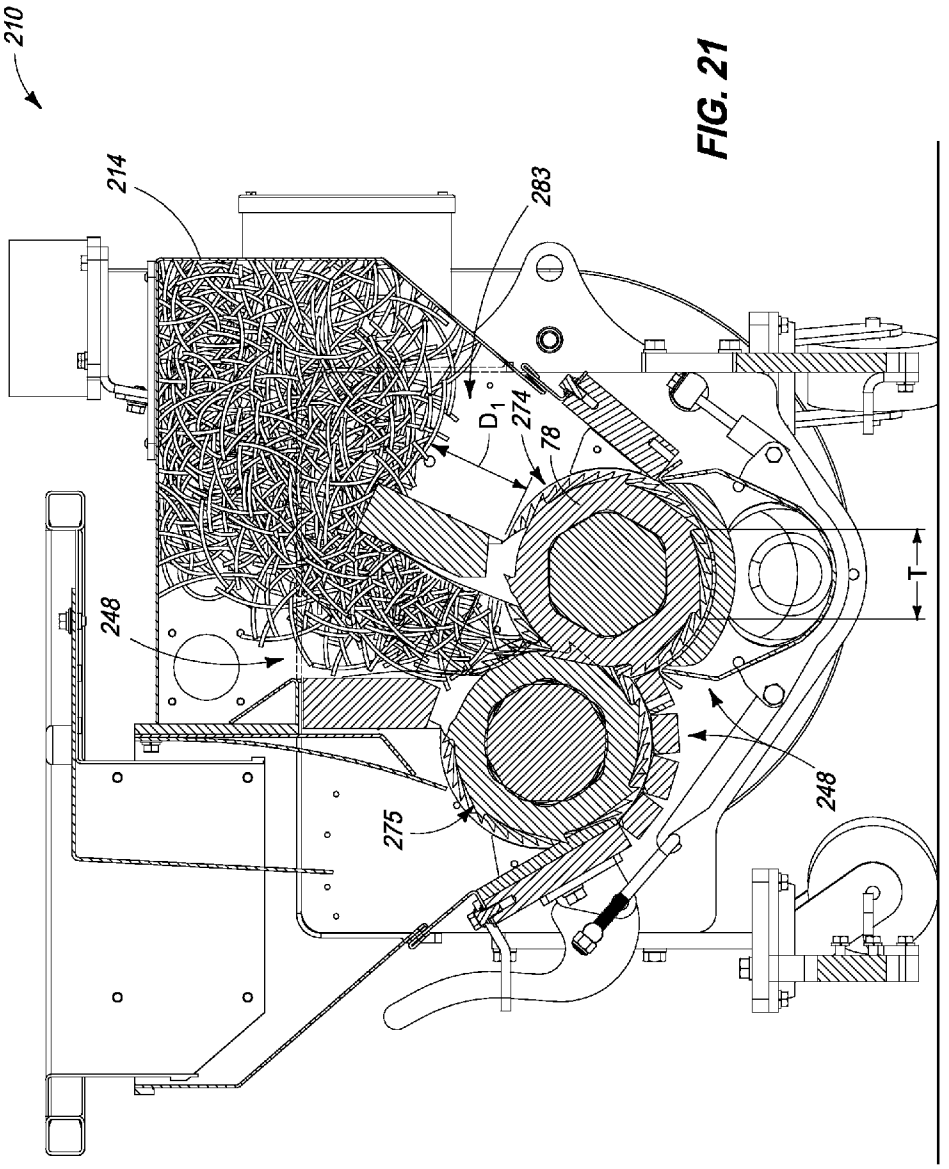

FIG. 21

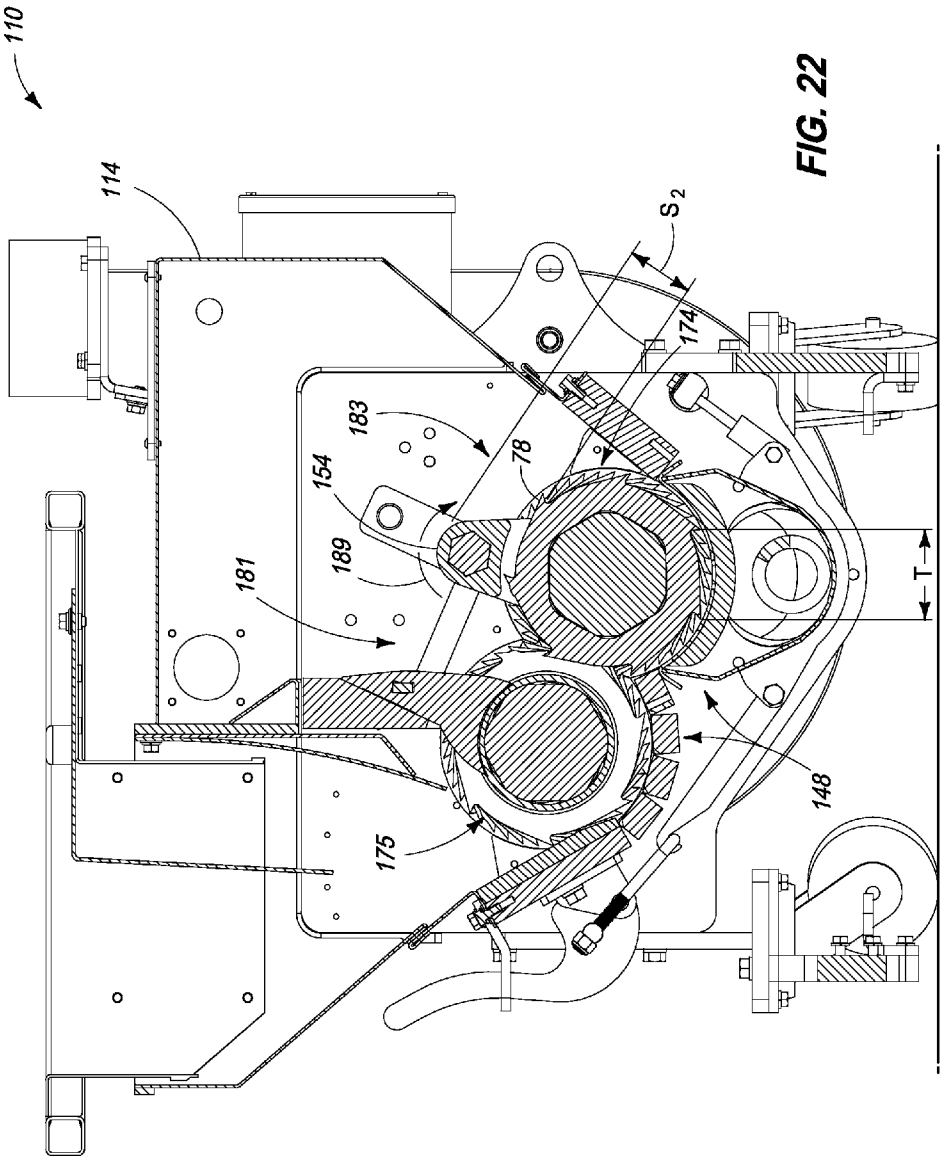

FIG. 22

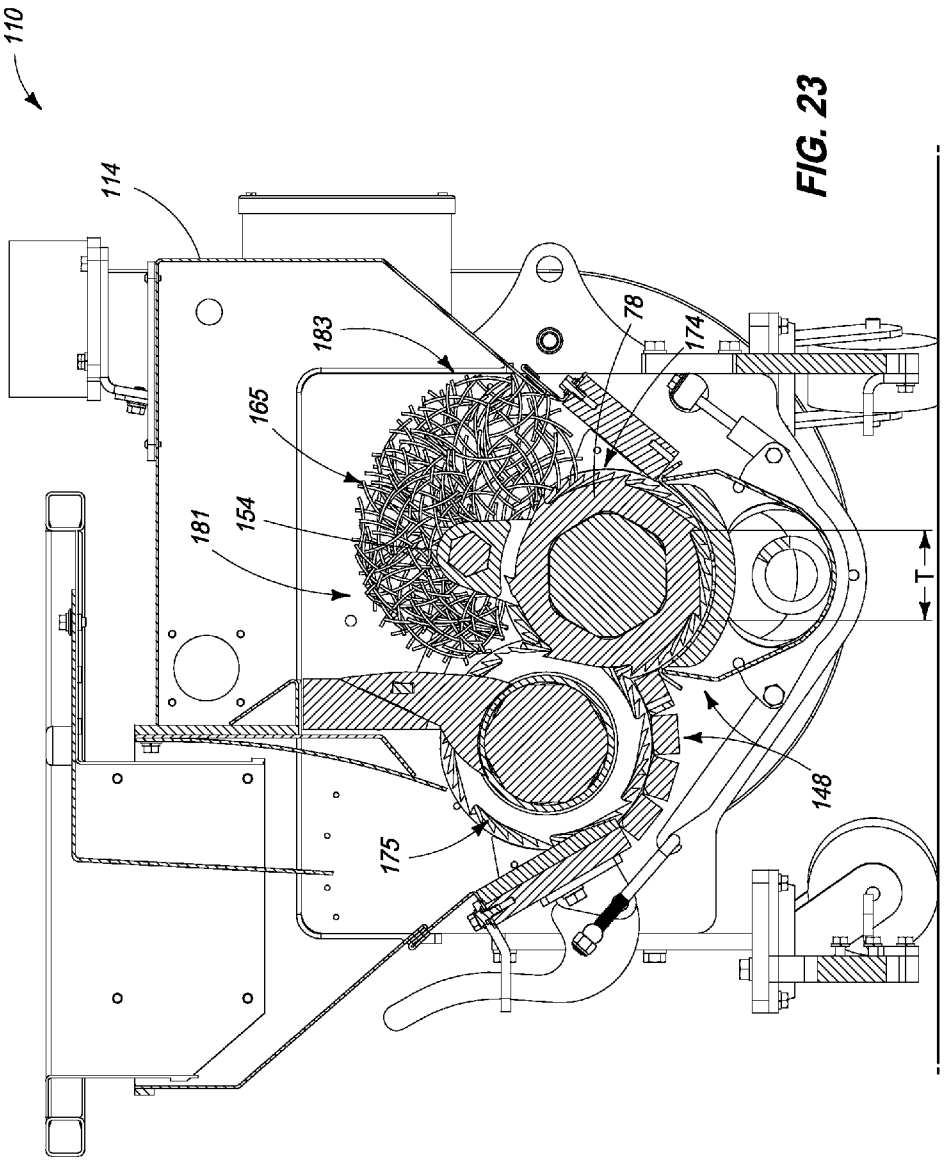

FIG. 23

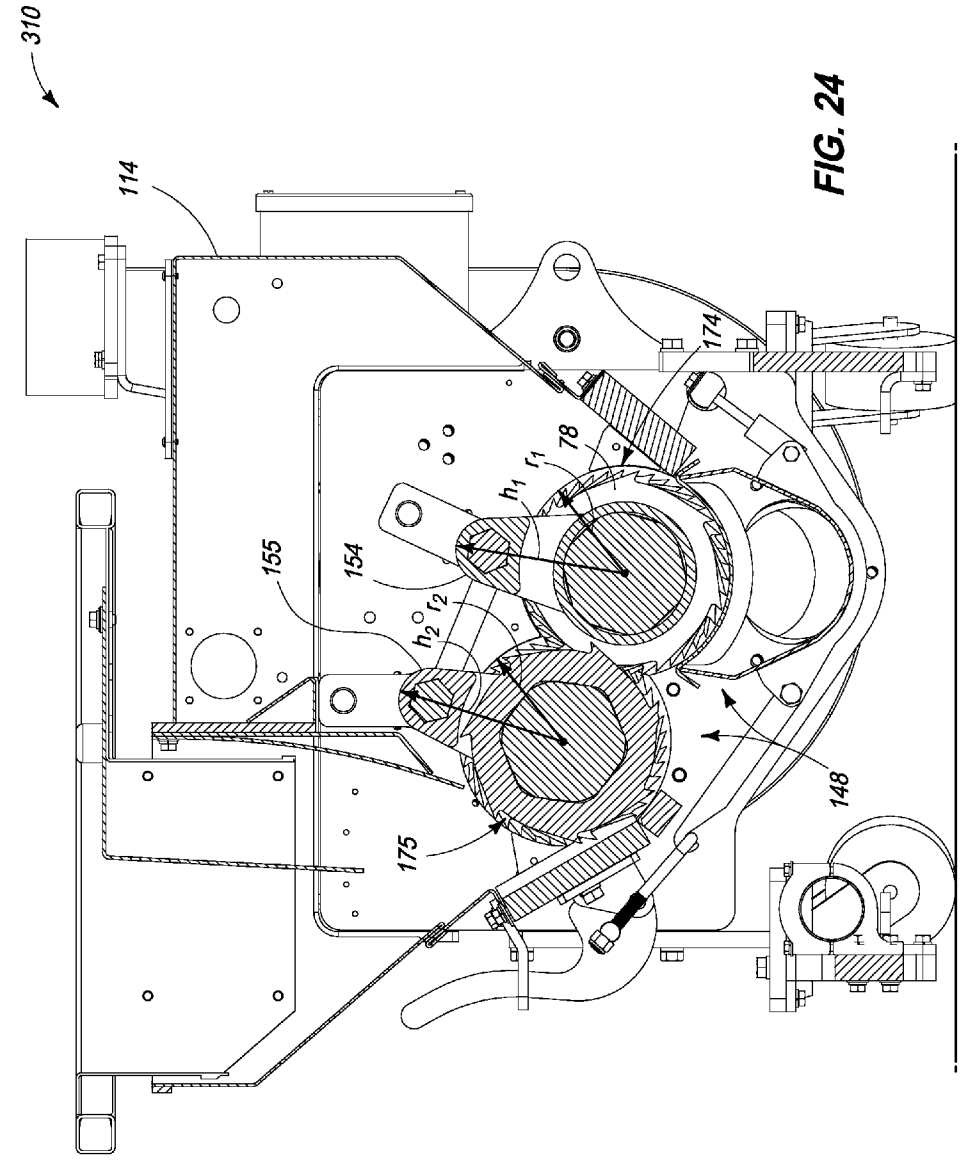

FIG. 24

APPARATUS FOR CIRCULATING COMMINUTED MATERIALS

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Patent Application Ser. No. 61/584,149 which was filed on Jan. 6, 2012, the entirety of which is incorporated by reference herein.

TECHNICAL FIELD

[0002] The presently disclosed subject matter pertains to apparatus for subdividing waste materials. More particularly, the presently disclosed subject matter relates to apparatus for comminuting solid waste materials, such as plastic sheet material.

BACKGROUND OF THE INVENTION

[0003] Techniques are known for severing waste material, particularly plastic sheet material, into small, rather uniform particles or pieces that can be readily recycled by passing the material between a pair of scissor rolls. Improvements are needed in how material is circulated through and/or around a pair of scissor rolls.

SUMMARY OF THE INVENTION

[0004] An improved scraper plate assembly is provided on a comminuting device having compliant rounded edges, sloped walls, and reduced height for placement along recycle flow paths within a comminuting apparatus when circulating subdivided waste material from between a pair of scissor rolls for further delivery to a scissor roll for further movement and subdividing of the subdivided waste material.

[0005] According to one aspect, an apparatus is provided for circulating comminuted materials. The apparatus includes a frame, a pair of scissor rolls, and a scraper plate. The pair of scissor rolls is carried for counter-rotation by the frame. The scraper plate is inter-nested with one of the scissor rolls and has a rounded outermost end, a pair of opposed and sloped side walls, and a profile height extending beyond an outer surface of the scissor roll a distance less than a diameter of the scissor roll.

[0006] According to another aspect, a comminuting apparatus is provided having a frame, a pair of overlapping scissor rolls, and a scraper plate. The frame has an enclosure with an entrance for receiving sold waste material, an entrance manifold, and a recycle manifold. The pair of overlapping scissor rolls is carried for counter-rotation by the frame. The scraper plate is carried by the frame and inter-nested with one of the scissor rolls and has a rounded outermost end, a pair of opposed and sloped side walls, and a profile outermost dimension extending in a radially outward direction from an outermost surface of the one scissor roll through a center axis of the one scissor roll less than a diameter of the scissor roll. The scraper plate communicates with at least one of the recirculation manifold and the recycle manifold to enable subdivided scrap material to cascade over the outermost end and into one of the recirculation manifold and the recycle manifold.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Preferred embodiments of the disclosure are described below with reference to the following accompanying drawings.

[0008] FIG. **1** is a perspective view from above of one comminuting apparatus with a scraper plate assembly having an improved geometry for enhancing the circulation of severed waste material around scissor rolls.

[0009] FIG. **2** is a perspective view from above of the comminuting apparatus of FIG. **1** with portions removed to facilitate depiction of internal components including two pairs of scissor rolls, each having improved scraper plate assemblies.

[0010] FIG. **3** is back view of the comminuting apparatus of FIG. **1**.

[0011] FIG. **4** is a front view of the comminuting apparatus of FIGS. **1** and **3**.

[0012] FIG. **5** is a left side view of the comminuting apparatus of FIGS. **1** and **3-4**.

[0013] FIG. **6** is a right side view of the comminuting apparatus of FIGS. **1** and **3-5**.

[0014] FIG. **7** is a plan view from above of the comminuting apparatus of FIGS. **1** and **3-6**.

[0015] FIG. **8** is a bottom view of the comminuting apparatus of FIGS. **1** and **3-7**.

[0016] FIG. **9** is a vertical sectional view taken along line **9-9** of FIG. **8**.

[0017] FIG. **10** is an enlarged partial and sectional view of the pairs of scissor rolls within the comminuting apparatus and corresponding with the sectional view taken in FIG. **9**.

[0018] FIG. **11** is a further enlarged view of a scissor roll taken from encircled region **11** of FIG. **10**.

[0019] FIG. **12** is a perspective view from above of an alternative construction comminuting apparatus with a scraper plate assembly having an improved geometry for enhancing the circulation of severed waste material around scissor rolls.

[0020] FIG. **13** is a vertical sectional view of the comminuting apparatus of FIG. **12** taken along line **13-13**.

[0021] FIG. **14** is a component end view in partial vertical sectional view showing the pair of scissor rolls of FIG. **13**.

[0022] FIG. **15** is a partially exploded perspective view of a low profile scraper plate assembly of FIGS. **12-14**, as well as one of the low profile scraper plate assemblies of FIG. **24**.

[0023] FIG. **16** is a vertical sectional view taken along line **16-16** of FIG. **15**.

[0024] FIG. **17** is a partially exploded perspective view of another one of the scraper plate assemblies of FIG. **24**.

[0025] FIG. **18** is a component vertical sectional view depicting interaction between a stripper finger, or beak and an associated ring.

[0026] FIG. **19** is a vertical sectional component view taken along line **19-19** of FIG. **18** and depicting interaction of a grooved ring with a single stripper finger, or beak.

[0027] FIG. **20** is a vertical sectional view of an alternatively constructed comminuting apparatus having a less preferred scraper plate assembly having a tendency to clog with subdivided waste material under certain operating conditions.

[0028] FIG. **21** is a vertical sectional view of the alternatively constructed comminuting apparatus of FIG. **20** showing a clog of subdivided waste material within the enclosure.

[0029] FIG. **22** is a vertical sectional view of the comminuting apparatus **110** of FIGS. **12-20** with a preferred scraper plate assembly having a tendency to minimize or eliminate clogging of subdivided waste material.

[0030] FIG. **23** is a vertical sectional view of the comminuting apparatus of FIGS. **12-20** and **22**, depicting the movement of subdivided waste material being circulated or recirculated within the enclosure in a manner that reduces or eliminates clogging.

[0031] FIG. **24** is an optional construction over that depicted in FIGS. **12-13**, and includes the scraper plate assemblies of FIGS. **15** and **17**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] This disclosure is submitted in furtherance of the constitutional purposes of the U.S. Patent Laws "to promote the progress of science and useful arts" (Article 1, Section 8).

[0033] FIG. **1** is a perspective view from above of one comminuting apparatus **10** with a scraper plate assembly **54-56** (see FIG. **2**) having an improved geometry for enhancing the circulation of severed waste material around scissor rolls **74-77** (see FIG. **10**). Comminuting apparatus **10** includes a frame **12** that includes an enclosure **14**. Enclosure **14** includes a front wall **16**, side walls **18** and **20**, back wall **22** (see FIG. **3**), bottom wall **24** (see FIGS. **5** and **8**) and top wall **26** (see FIG. **7**). Side plates (or side frames) **58** and **60** form a portion of each side wall **18** and **20** (see FIG. **1**). Frame **12** may be supported on legs **44** that each have individual pairs of wheels **46** at each end (see FIGS. **1-9**).

[0034] Comminuting apparatus **10** includes a top material receiving duct **28** with a material entrance **32** and a side material receiving duct **30** with a material receiving entrance **34**. Entrance **32** includes three guards **33**, each comprising three parallel steel rods extending across the entrance to prevent user access during use. A control cabinet **42** houses a controller and associated components for controlling operation of comminuting apparatus **10**. A first scissor roll drive motor assembly **36** drives a pair **48** of scissor rolls **74**, **75** (see FIG. **10**) and a second scissor roll drive motor assembly **38** drives a pair **50** of scissor rolls **76**, **77** (see FIG. **10**). Each drive motor assembly **36** and **38** comprises a variable speed AC drive motor, a speed reduction gearbox, and a flux vector AC drive (housed in cabinet **42**).

[0035] FIG. **2** is a perspective view from above of the comminuting apparatus **10** of FIG. **1** with portions removed to facilitate depiction of internal components including two pairs **48** and **50** of scissor rolls **74-75** and **76-77** (see FIG. **10**), each having improved scraper plate assemblies **54-56**. Scraper plate assemblies **54-56** each have a rounded outer, or top end, sloped side walls, and a lowered profile height that promotes movement of entangled masses of subdivided waste material over each scraper plate assembly and back to a respective scissor roll for cutting and further delivery of further subdividing between a respective pair of scissor rolls. Hence, a clogging or compaction condition of waste material depicted in FIG. **21** is reduced or eliminated. The provision of ends that are rounded, smoothed, radius, or otherwise unlikely to discourage passage of a mass of subdivided waste material from moving past a scraper plate provides a significant benefit for many types of plastic materials being recycled in a comminuting apparatus.

[0036] Also shown in FIG. **2**, an in-feed roll **52** is driven in co-rotation with pair **48** of scissor rolls **74**, **75** (see FIG. **10**) by drive motor assembly **38** to draw scrap material into material entrance **32** (see FIG. **1**). Scraper plate assemblies **54-56** are affixed at opposed ends to side plates **58** and **60**, respectively.

[0037] FIG. **3** is back view of the comminuting apparatus **10** of FIG. **1**. Drive motor assemblies **36** and **38**, and pneumatic conveyor **40** extend outwardly from apparatus **10**. As shown in FIG. **4**, a front view of the comminuting apparatus **10** of further illustrates arrangement of drive motor assemblies **36** and **38**, and pneumatic conveyor **40**. As seen in FIG. **5**, a left side view of the comminuting apparatus **10** further illustrates orientation of material receiving ducts **28** and **30** relative to enclosure **14**. As shown in FIG. **6**, a right side view of the comminuting apparatus **10** illustrates positioning of control cabinet **42**, motor **38** and conveyor **40**. FIG. **7** further shows in plan view from above the comminuting apparatus **10** with three guards **33** provided across material entrance **32**. FIG. **8** depicts in bottom view the arrangement of motor assemblies **36** and **38**, conveyor **40**, and cabinet **42** of the comminuting apparatus **10**.

[0038] FIG. **9** is a vertical sectional view taken along line **9-9** of FIG. **8** illustrating pair **48** of scissor rolls configured to receive scrap material from side material receiving duct **30** and from top material receiving duct **28** by way of in-feed roll **52**. Subdivided waste material that has passed between pair **48** is drawn down beneath and between pair **50** where further subdivided scrap material exits over the top of one or both of scraper plate assemblies **55** and **56**. Further subdivided scrap material that passes over the top of scraper plate assembly **55** then passes downwardly by the outer end, or top of scraper plate assembly **54** to be drawn beneath and between pair **50** for further subdividing of such waste material. Each time subdivided waste material passes over scraper plate assembly **56** and beneath the left-most scissor roll of pair **50**, such material passes along a separator screen **65** (see FIG. **10**). Sufficiently small scrap material then drops beneath screen **65** where it is drawn out via pneumatic conveyor **40** (see FIG. **8**).

[0039] FIG. **10** is an enlarged partial and sectional view of the pairs **48** and **50** of scissor rolls **74-75** and **76-77** within the comminuting apparatus **10** and corresponding with the sectional view taken in FIG. **9**. A pair of cross members **68** and **70** each carry a series of spaced-apart fingers, or bolts that co-act with discrete fingers on feed roll **52** while drawing in scrap material from above. Scissor roll **75** is supported between another pair of cross members **64** and **72**. Cross member **64** comprises another scraper plate assembly that clears scrap material from around scissor roll **75**. Finally, cross member **66** is provided adjacent scissor roll **77**. Cross members **64**, **66**, **68**, **70**, and **72** are mounted at opposite ends to respective end plates of side walls **18** and **20** (see FIG. **4**).

[0040] FIG. **11** is a further enlarged view of a scissor roll **77** and scraper plate assembly **56** taken from encircled region **11** of FIG. **10**. Hexagonal shaft **84** of scraper plate assembly **56** (see FIG. **10**) is affixed at a far end to end mounting bracket **86** so as to prevent rotation. Bracket **86** and shaft **84** are constructed essentially the same as bracket **186** and shaft **184** (of FIG. **15**). In fact, scraper plate assemblies **54-56** are each constructed in the same manner as scraper plate assembly **154** (of FIG. **15**). However, the only difference is that each individual assembly in a pair is mounted 180 degrees in the opposite direction. As shown, each beak (stripper finger) **90** rings in a complementary cylindrical outer surface groove in ring **80**. Each beak **90** has a complementary hexagonal aperture in beak **90** that supports beak **90** on hexagonal shaft **84** so as to prevent any rotation, as bracket **86** (and opposite end bracket) secure shaft **84** to the frame of the comminuting apparatus.

[0041] FIGS. **12-14** and **22-23** illustrate an alternative construction comminuting apparatus **110** with a scraper plate assembly **154** having an improved geometry for enhancing the circulation of severed waste material around scissor roll **174**. Scraper plate assembly **154** is constructed in a similar manner to scraper plates **54-56** in the embodiment of FIGS. **9-10**. FIGS. **15** and **16** illustrate a modified construction for the embodiment depicted in FIGS. **12-14** and **22-23**, wherein both scraper plate assemblies **154** and **155** are constructed in a similar manner (but mounted 180 degrees relative to one another), and wherein scraper plate assembly **155** replaces scraper plate **164** in the embodiment of FIG. **12**. For the modified embodiment of FIGS. **17** and **24** (and FIG. **15**), scraper plate **155** enables subdivided material to cascade over the top of scraper plate assembly, in a way similar to how subdivided material passes over scraper plate assembly **55** in the embodiment depicted in FIG. **9**.

[0042] As shown in FIG. **12**, a material entrance **132** is provided atop material receiving duct **128** for receiving scrap material, such as thermoforming sheet scrap material. A scissor roll drive motor assembly **136** drives rolls **174** and **175** (see FIG. **13**) in counter-rotation via a gear assembly. A pneumatic conveyor **140** provides a flow of air to remove sorted, small scrap material from within enclosure **114** of apparatus **110**. Drive motor assembly **136** and pneumatic conveyor **140** are each mounted to frame **112** of apparatus **110**. Legs **44** and pairs of wheels **46** are also mounted to frame **112** to facilitate movement of apparatus **110** during maintenance and cleaning.

[0043] FIG. **13** is a vertical sectional view of the comminuting apparatus **110** of FIG. **12** taken along line **13-13**. More particularly, scrap material (from material entrance **132** of FIG. **12**) enters an intake manifold **179** where it is drawn around and beneath scissor roll **175** (by individual scissor rings **78**) for subdividing between pair **148** of scissor rolls **174** and **175** for delivery up into recycle manifold **181**. Subdivided scrap material then cascades over scraper plate assembly **154** for delivery into recirculation cavity, or manifold **183** via cascading flow path (or waterfall) **189**. Such subdivided material is then further drawn by scissor roll **174** beneath roll **174** and screen **187** where sufficient small scrap material drops into an outtake manifold **185** for removal via airflow from pneumatic conveyor **140** (see FIG. **12**). A rigid cross member mounted to end plates (such as plate **158**) provides a scraper plate assembly **164**. Assembly **164** (of FIG. **13**) can be replaced with a scraper plate assembly similar to scraper plate assembly **154**, as shown in FIG. **15**, according to an optional construction.

[0044] FIG. **14** is a component end view in partial vertical sectional view showing the pair of scissor rolls **174** and **175** of FIG. **13**. Rolls **174** and **175** of apparatus **110** rotate in counter rotation, and are geared together at one end. Scraper plate assembly **154** is shown interacting with roll **174**, between adjacent scissor rings **78** of pair **148**.

[0045] FIG. **15** is a partially exploded perspective view of a scraper plate assembly **154** of FIGS. **12-14**. Optionally, FIG. **15** also combines with the scraper plate assembly of FIG. **17** to provide the optional construction comminuting apparatus **310** of FIG. **24**. More particularly, assembly **154** of FIG. **15** includes an elongate steel hexagonal shaft **184** having a threaded bore **199** provided in each end. A threaded fastener **193** at each end secures a mounting bracket **186** and **187** at respective opposite ends, while also securing an end plate **188** at the end adjacent bracket **186**. End plate **188** and bracket **187** retain a successively stacked arrangement of alternating beaks (or stripper fingers) **190** and spacer plates **192** along hexagonal shaft **184**. A hexagonal, or star-shaped recess in bracket **187** fixes shaft **184** (as well as beaks **190**, end plate **188**, and spacer plates **192**) from rotating relative to bracket **187**. Bracket **187** is then fixed onto side plate **158** (or **158'**), thereby preventing any rotation of beaks **190** relative to the frame of the comminuting apparatus. Stripper fingers **190** each have a complementary hexagonal bore **173** that fits about shaft **184**, thereby preventing rotation. Likewise, spacer plates **192** each have a complementary hexagonal bore **177** that fits about shaft **184**, thereby also preventing rotation. Each mounting bracket **186** has a spherically cut keyway slot **196** that mates with a complementarily-shaped (or cylindrical) dowel pin **194**. Each dowel pin **194** is affixed to a respective side plate **158** (or **158'**, per optional construction) and **160** (see FIG. **13**) with a threaded fastener **195** that is threaded into a threaded bore **164** in complementary slot **162** in side plate **158** (or **158'**). Threaded fastener **191** is then passed through a respective bore **163** in each end plate, so as to secure scraper plate **154** within the housing or enclosure **114** (see FIG. **12**). Each bore **163** is actually elliptical, enabling up and down adjustment of brackets **186** and **187** along the main axis of slots **162** to ensure precise fit-up of each beak **190** along a respective ring **180** (see FIGS. **18** and **19**).

[0046] FIG. **16** is a vertical sectional view taken along line **16-16** of FIG. **15** illustrating fit-up between the hexagonal shaft **184** and the hexagonal, or star-shaped (with corner reliefs) end aperture **171** provided within end bracket **187**. Such fit-up between shaft **184** and aperture **171** prevents any rotation between bracket **187** (and end plate **158**, **158'**) and shaft **184** (and beaks **190**). Such construction provides torsional rigidity that is particularly desirable when beaks **190** are subjected to scrap material movement and compaction within a comminuting apparatus. Otherwise, such beaks can be subjected to undue wear and even structural failure due to material loading and (sometimes) jamming within the comminuting apparatus. Furthermore, such jamming can create friction, which can further cause melting of scrap material, which further jams the comminuting apparatus. Optionally, provision of bore **171** in end bracket **187** can be slightly oversized in depth so as to enable a minute amount of "floating" of beaks **190** between respective scissor rings, as tightening of fasteners **193** into shaft **184** at each end does not clamp together beaks **190** and spacers **192**.

[0047] FIG. **17** is a partially exploded perspective view of another one of the scraper plate assemblies of FIG. **24**, namely scraper plate assembly **155**. Scraper plate assembly **155** is identical to scraper plate assembly **154**, but is mounted in a reverse (or 180 degree rotated) direction relative to assembly **154**. In the optional construction of FIG. **24**, scraper plate assembly **155** replaces scraper plate **164** (of FIG. **13**). Accordingly, end bracket **187** is provided at an opposite end (than for assembly **154**), and end bracket **186** is also provided at an opposite end (than for assembly **154**). Scraper plate assembly **155** is mounted by receiving dowel pins **194** into slot **166**, and engaging threaded fastener **195** into threaded bore **168**. Threaded bolt **191** is then received through elongated bore (or slot) **167** (from the outside) and threaded into threaded bore **197** (in brackets **186** and **187**, respectively). Fasteners **193** are threaded into threaded bores **199** in each end of rod **184** so as to secure beaks **190**, spacers **192** and end plate (or spacer) **188** together.

[0048] FIG. **18** is a component vertical sectional view depicting interaction between a selected stripper finger, or beak **190** and an associated ring **180** having an inwardly extending, complementary groove in the radial-outer surface for receiving the beak **190**.

[0049] FIG. **19** is a vertical sectional component view taken along line **19-19** of FIG. **18** and depicting interaction of grooved ring **180** with a single stripper finger, or beak **190**. Furthermore, the alternating assembly of adjacent beaks **190** and spacers **192** is clearly shown. Threaded fasteners **195** are each received within a threaded bore **164** of plate **158** or **158'** (see FIG. **15**).

[0050] FIG. **20** is a vertical sectional view of an alternatively constructed comminuting apparatus **210** having a less preferred scraper plate assembly **254** with sharp top corners, vertical sides, and higher top elevation, and having a tendency to clog with subdivided waste material under certain operating conditions. More particularly, scraper plate **254** has radially outwardly extending height (measured from the central axis of roll **274**) of nearly 10 inches, whereas roll **274** has a radius (to the outermost cutting tip) of 3.972 inches, according to one construction. Dimension "S**1**" exceeds the radius of roll **274**, which inhibits the ability of subdivided scrap material (that mats up inside of comminuting apparatus **210**) to be drawn downwardly by rings **78** beneath roll **274** for further subdividing. Hence, the elevation of scraper plate assembly **254** can lead to jamming of subdivided scrap material within apparatus **210**, as shown below with reference to FIG. **21**.

[0051] FIG. **21** is a vertical sectional view of the alternatively constructed comminuting apparatus **210** of FIG. **20** showing a clog of subdivided waste material within the enclosure **214**. Dimension "D**1**" is less than dimension "S**1**", shown in FIG. **20**. By reducing the height of the scraper plate assembly (using scraper plate assembly **154** of FIG. **22**), dimension "D**1**" becomes a nullity, and scrap material is drawn by scissor rings **78** of roll **154** for further subdividing, according to the embodiment of FIG. **22**.

[0052] FIG. **22** is a vertical sectional view of the comminuting apparatus **110** of FIGS. **12-16** and **18-19** with one embodiment scraper plate assembly **154** having a tendency to minimize or eliminate clogging of subdivided waste material. More particularly, the angled side faces of scraper plate assembly **154** combine with the reduced height end, and the rounded end to encourage flow of subdivided scrap material over waterfall path **154** for further passage around and beneath roll **174** for further subdividing between rolls **174** and **175** and sorting between roll **174** and the sorting screen.

[0053] FIG. **23** is a vertical sectional view of the comminuting apparatus **110** of FIGS. **12-20** and **22**, depicting the movement of subdivided waste material **154** being circulated or recirculated within the enclosure **114** in a manner that reduces or eliminates clogging. As shown in FIGS. **22-24**, roll **174** has a radius (to the outermost cutting tip) of 3.972 inches and the outermost tip of scraper plate assembly **154** has a distance (from the center of roll **174**) of 6.605 inches. In contrast, the distance for scraper plate assembly **254** is nearly 10 inches, which contributes to clogging of scrap material. It has been found that the combination of sloped side surfaces, rounded end, and relatively low profile on scraper plate assembly **154** facilitates flow of subdivided scrap material through comminuting apparatus **110**.

[0054] FIG. **24** is vertical sectional view of a further alternative construction comminuting apparatus **310** over apparatus **110** (depicted in FIGS. **12-13** and **22** and **23**). According to such construction, scraper plate assemblies **154** and **155** from FIGS. **15** and **17**, respectively, are utilized to reduce scrap material clearance over each scraper plate assembly **154** and **155**. According to one construction, $r_1=r_2=3.972$ inches. Also according to such one construction, $h_1=h_2=6.605$ inches. Such configuration provides a substantially reduced clearance profile for each scraper plate assembly over that depicted for the embodiment of FIGS. **20** and **21**. Optional dimensions can be used as long as a similar "lower-profile" is realized for a scraper plate assembly relative to a certain sized scissor roll (and scissor ring), one that does not realize clogging and matting of subdivided scrap material.

[0055] In compliance with the statute, embodiments of the invention have been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the entire invention is not limited to the specific features and/or embodiments shown and/or described, since the disclosed embodiments comprise forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted in accordance with the doctrine of equivalents.

The invention claimed is:

1. An apparatus for circulating comminuted materials, comprising:

a frame;

a pair of scissor rolls carried for counter-rotation by the frame;

a scraper plate inter-nested with one of the scissor rolls and having a rounded outermost end, a pair of opposed and sloped side walls, and a profile height extending beyond an outer surface of the scissor roll a distance less than a diameter of the scissor roll.

2. A comminuting apparatus, comprising:

a frame having an enclosure with an entrance for receiving sold waste material, an entrance manifold, and a recycle manifold;

a pair of overlapping scissor rolls carried for counter-rotation by the frame; and

a scraper plate carried by the frame and inter-nested with one of the scissor rolls and having a rounded outermost end, a pair of opposed and sloped side walls, and a profile outermost dimension extending in a radially outward direction from an outermost surface of the one scissor roll through a center axis of the one scissor roll less than a diameter of the scissor roll, the scraper plate communicating with at least one of the recirculation manifold and the recycle manifold to enable subdivided scrap material to cascade over the outermost end and into one of the recirculation manifold and the recycle manifold.

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