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(54) SNOW THROWER

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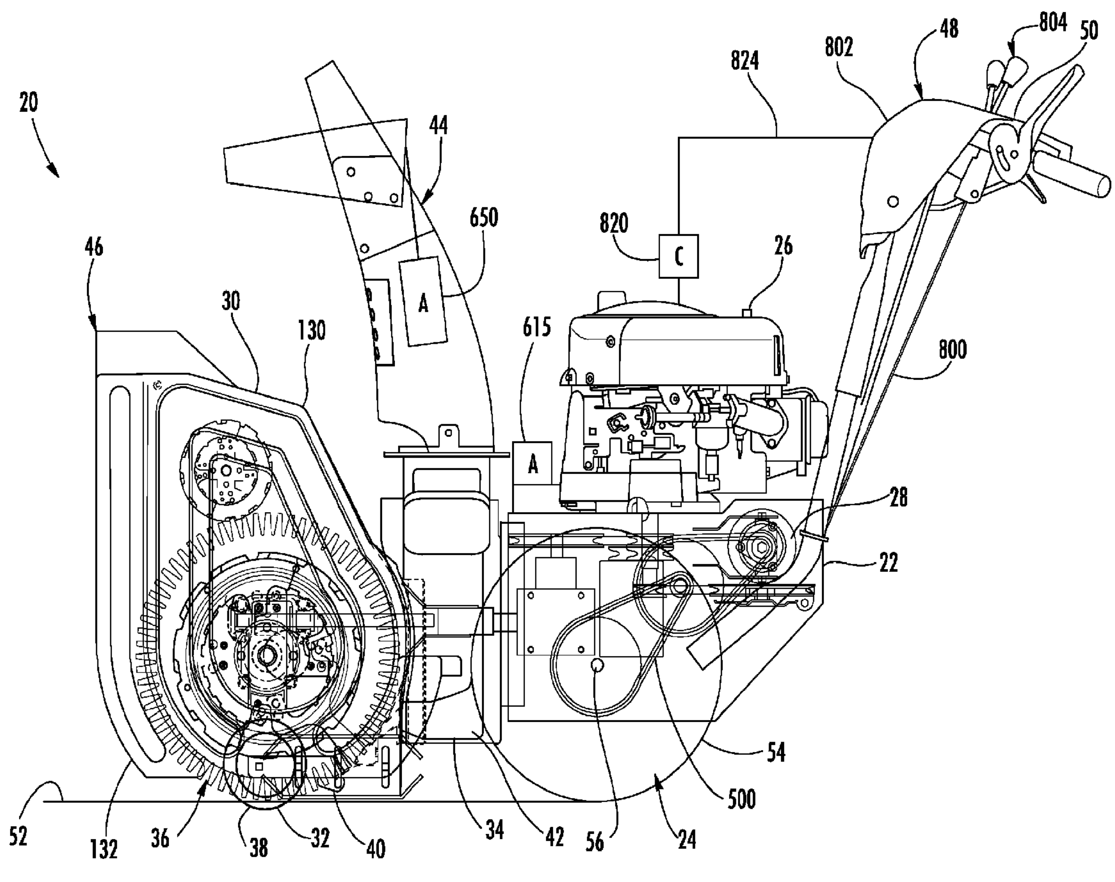
(57) **ABSTRACT**

A snow thrower including an auger housing, a center snow impelling blade housed within the auger housing, a first blade positioned on a first side of the center snow impelling blade and configured to be driven about a rotational axis of a drive shaft, and a second blade positioned on a second side of the center snow impelling blade and configured to be driven about the rotational axis of the drive shaft. The first blade and the second blade are housed within the auger housing and configured to drive snow to the center snow impelling blade. The auger housing directs snow to the center snow impelling blade, the first blade, and the second blade.



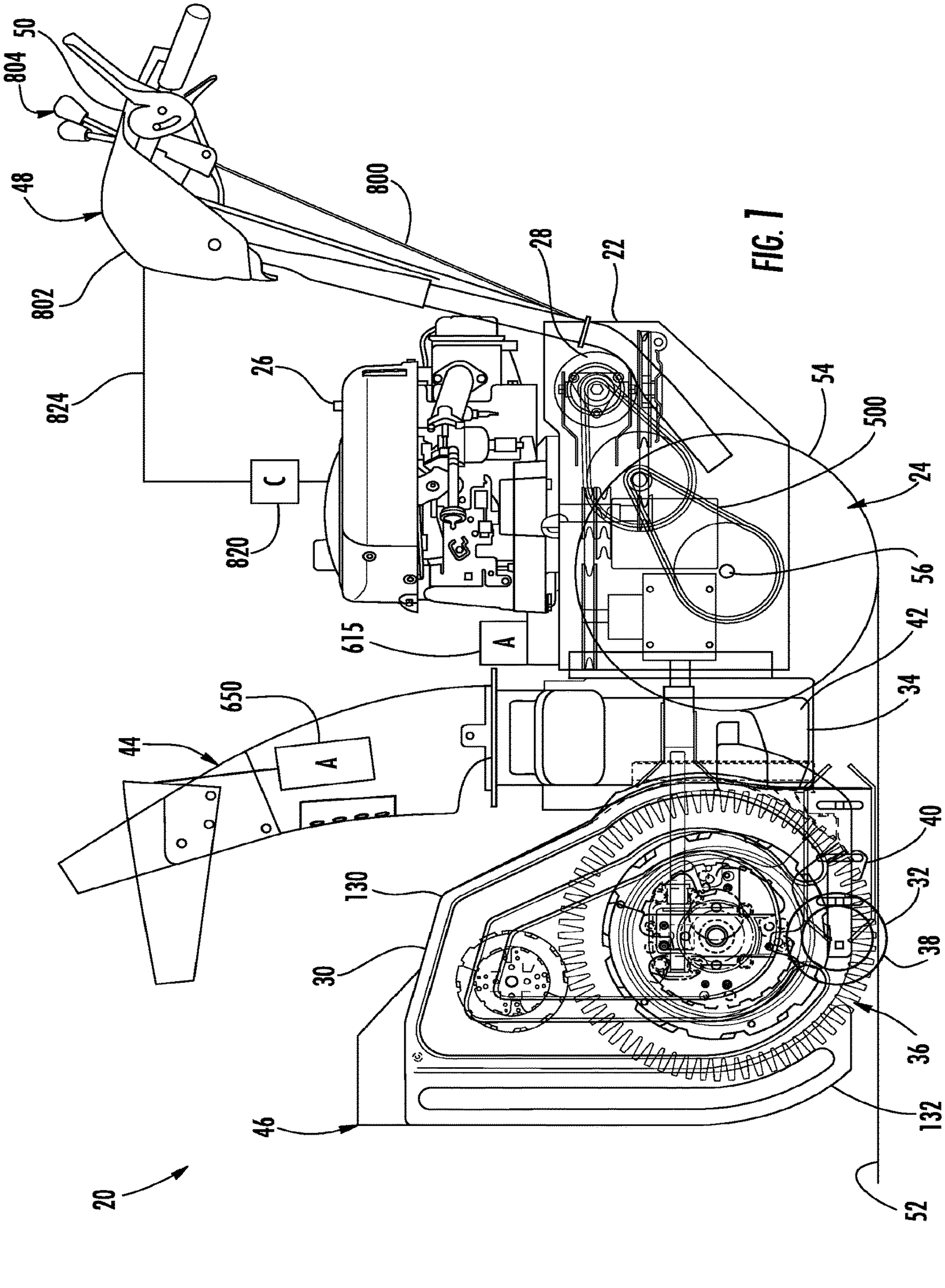

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FIG. 1

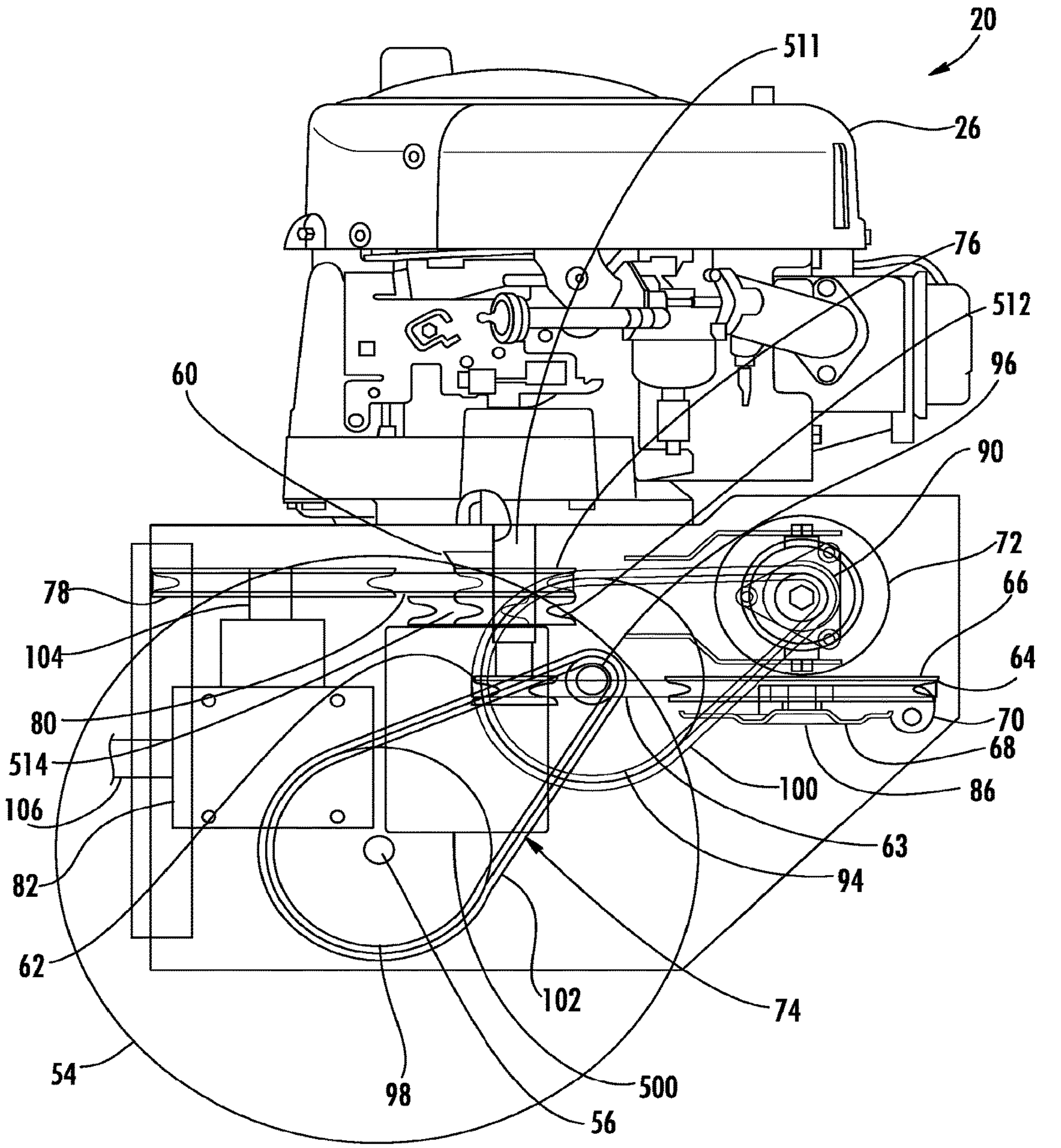
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FIG. 2

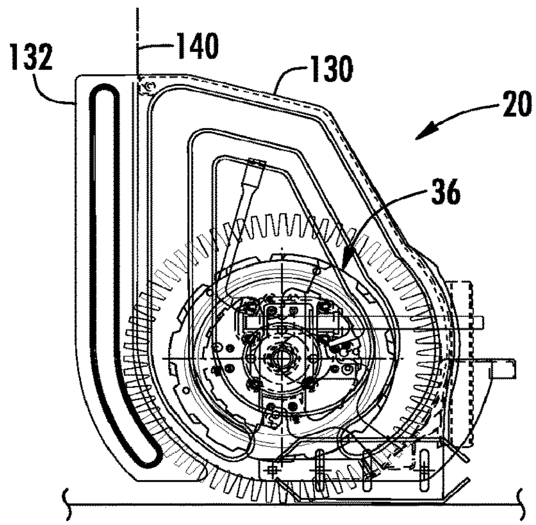

FIG. 3

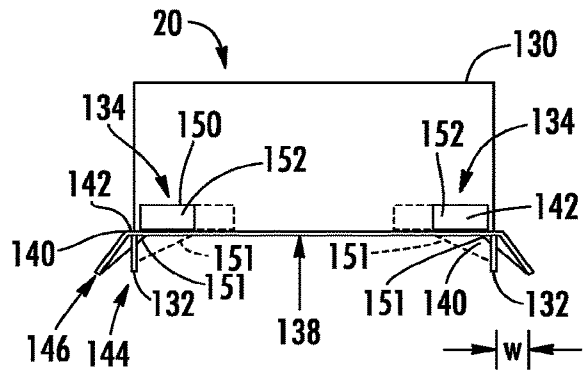

FIG. 4

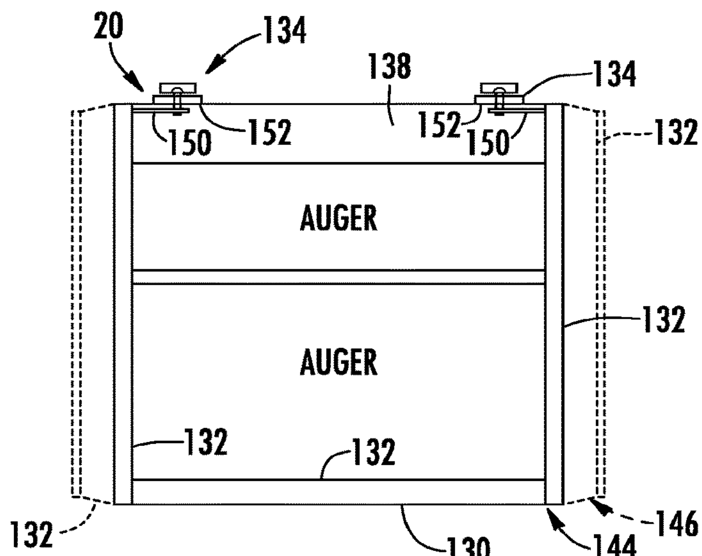

FIG. 5

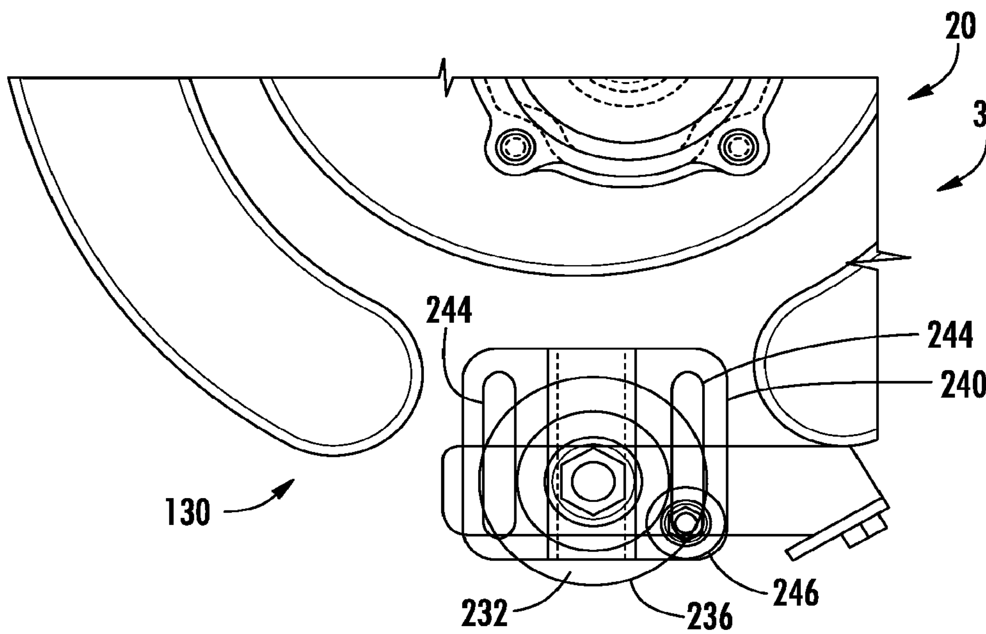

FIG. 6

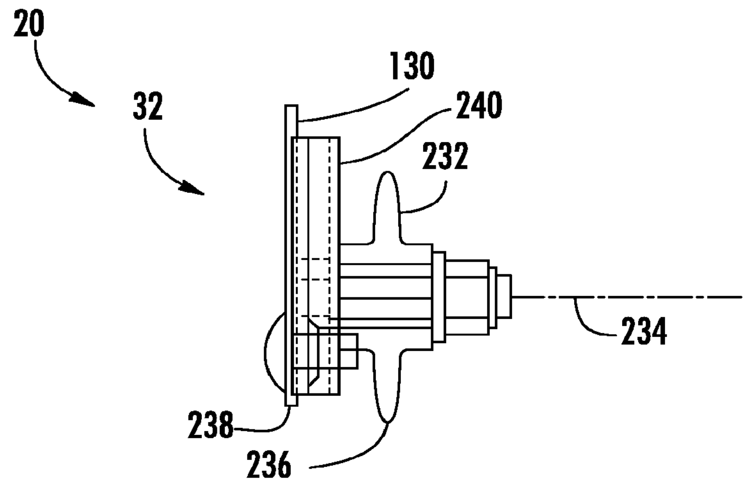

FIG. 7

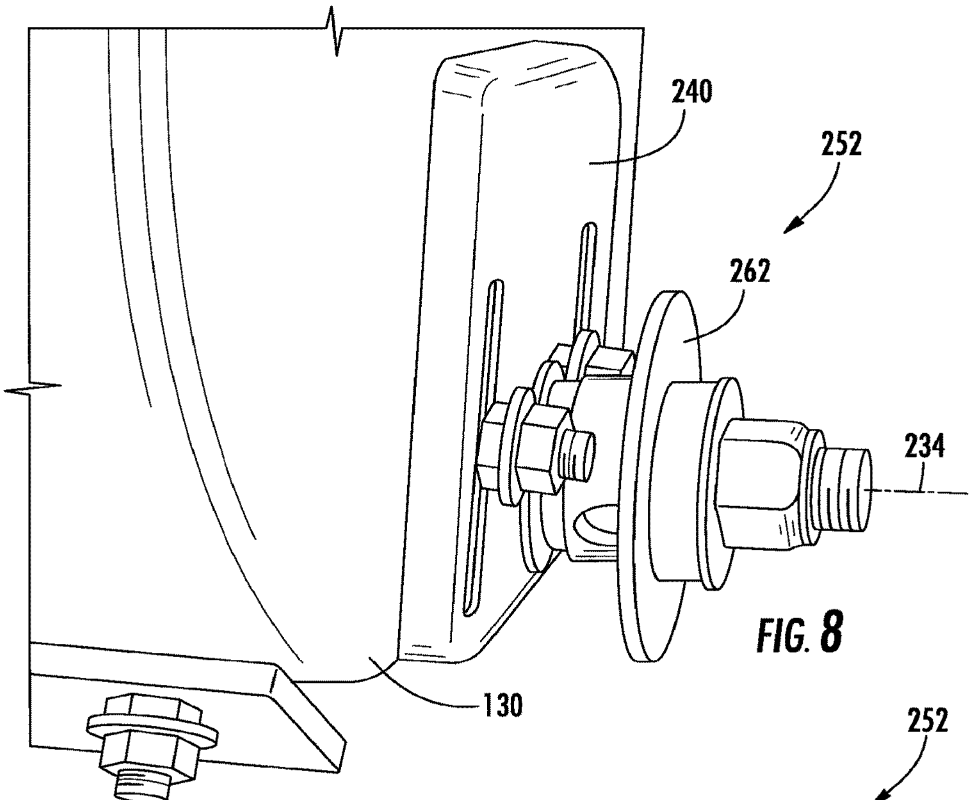

FIG. 8

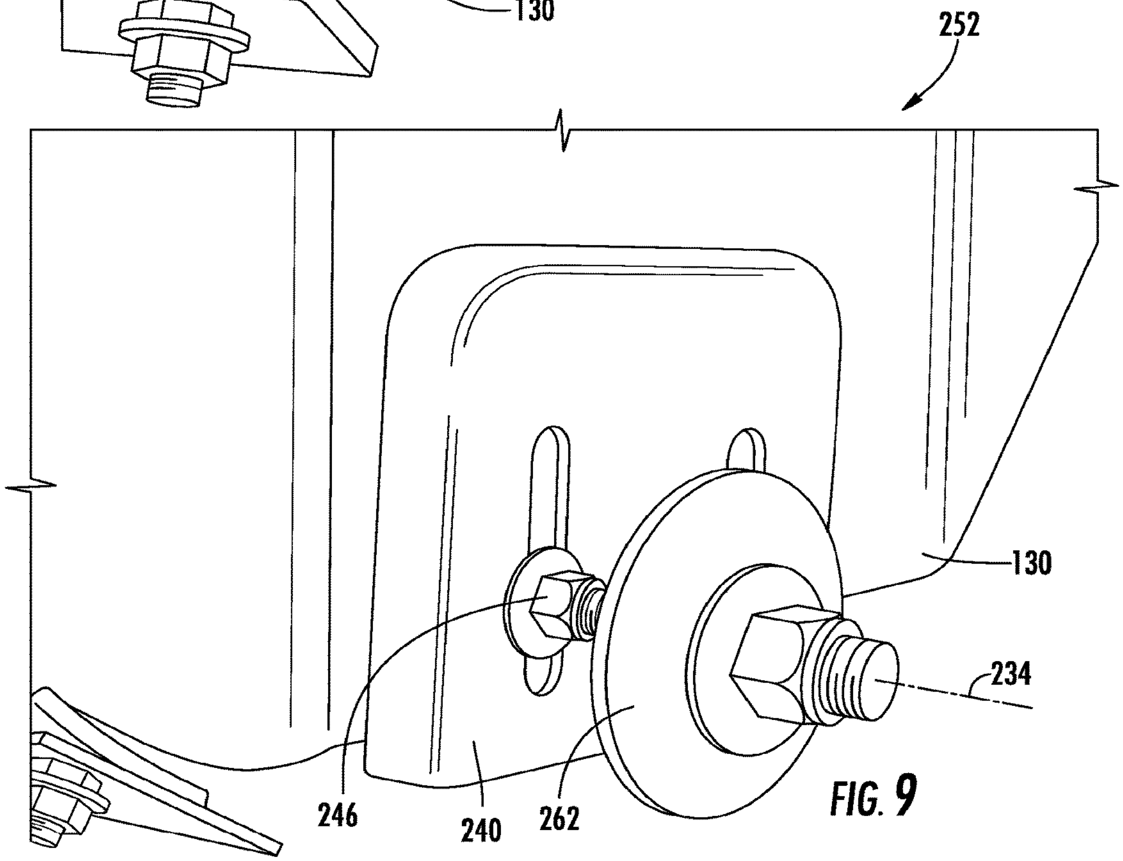

FIG. 9

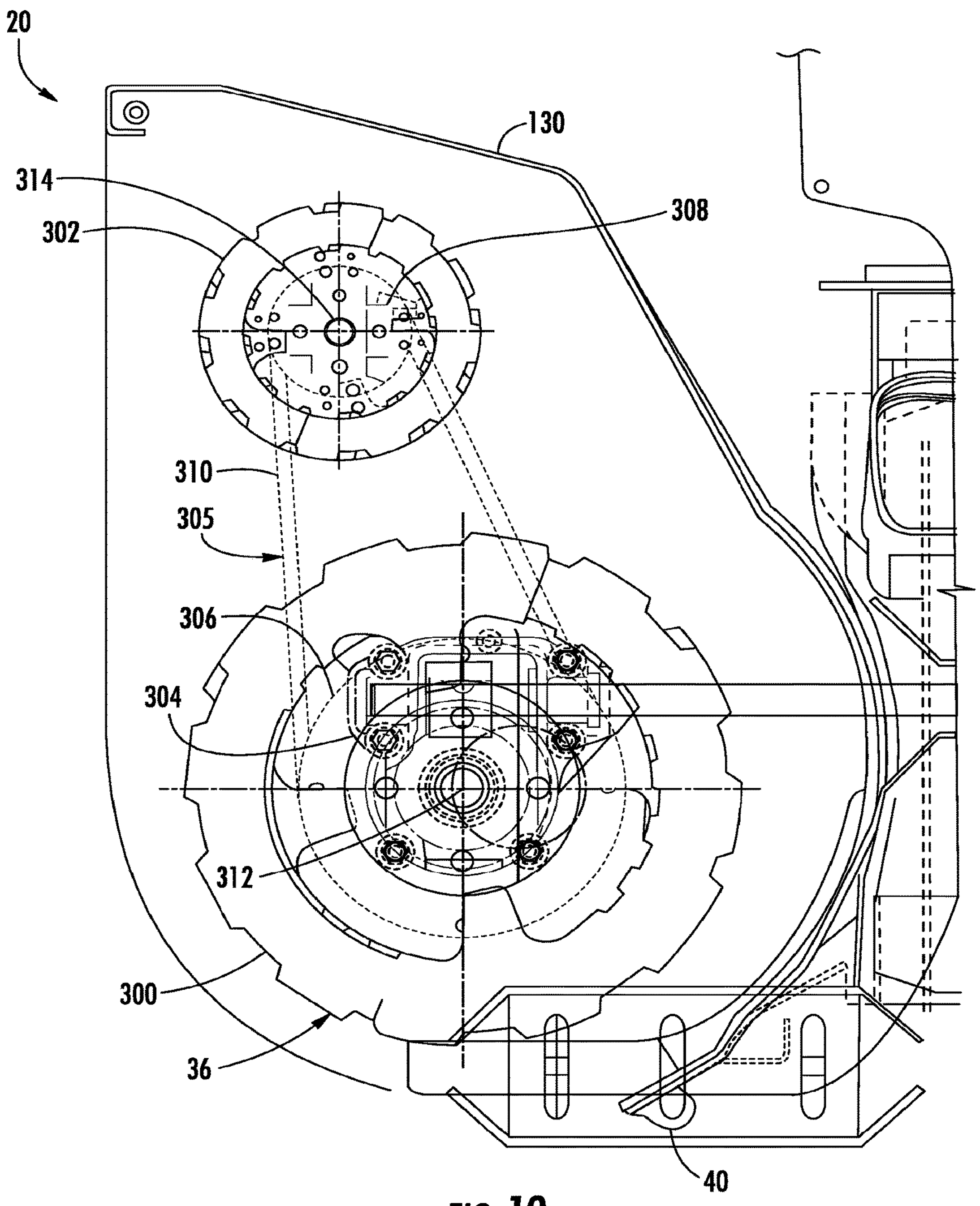

FIG. 10

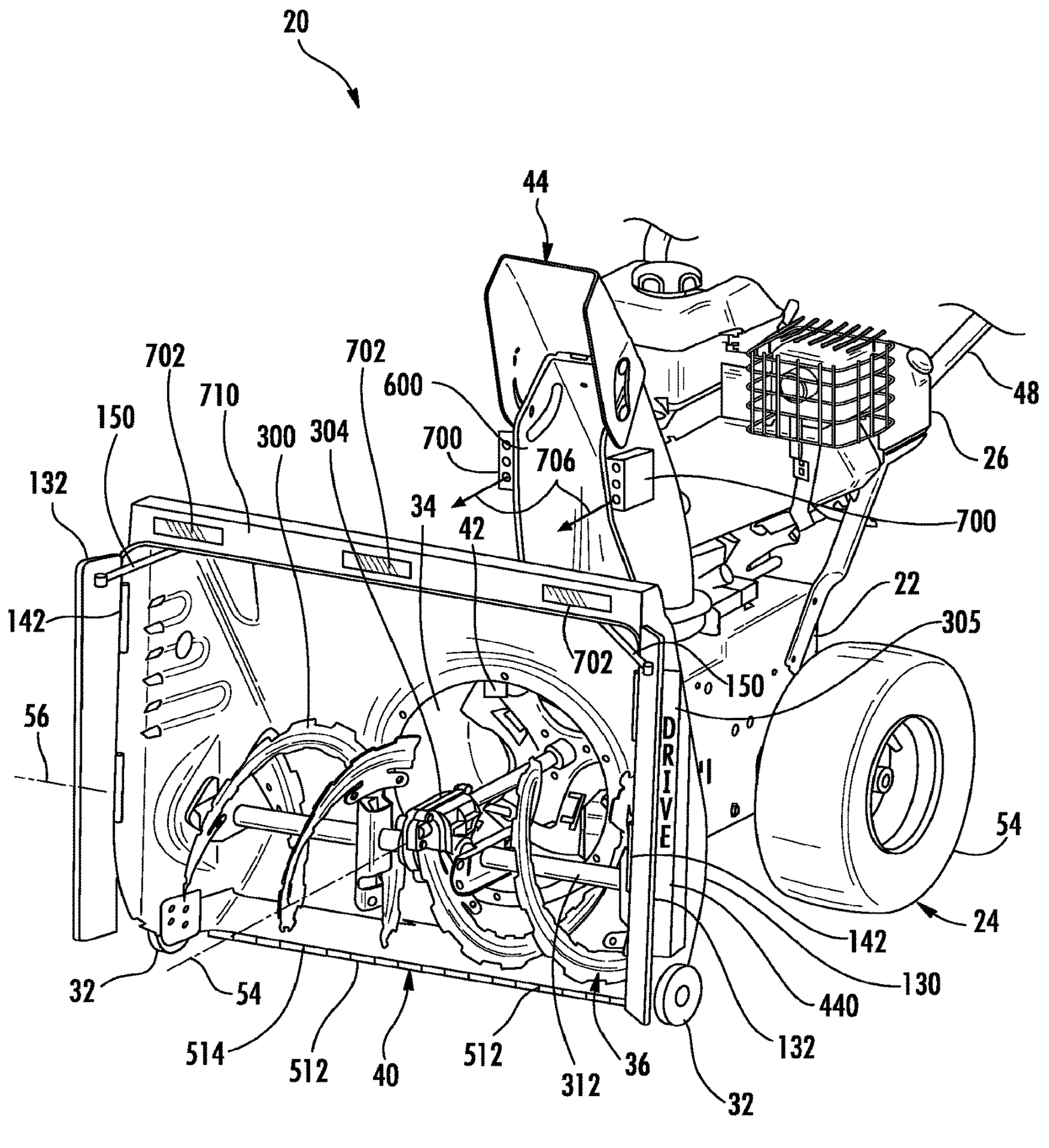
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FIG. 11

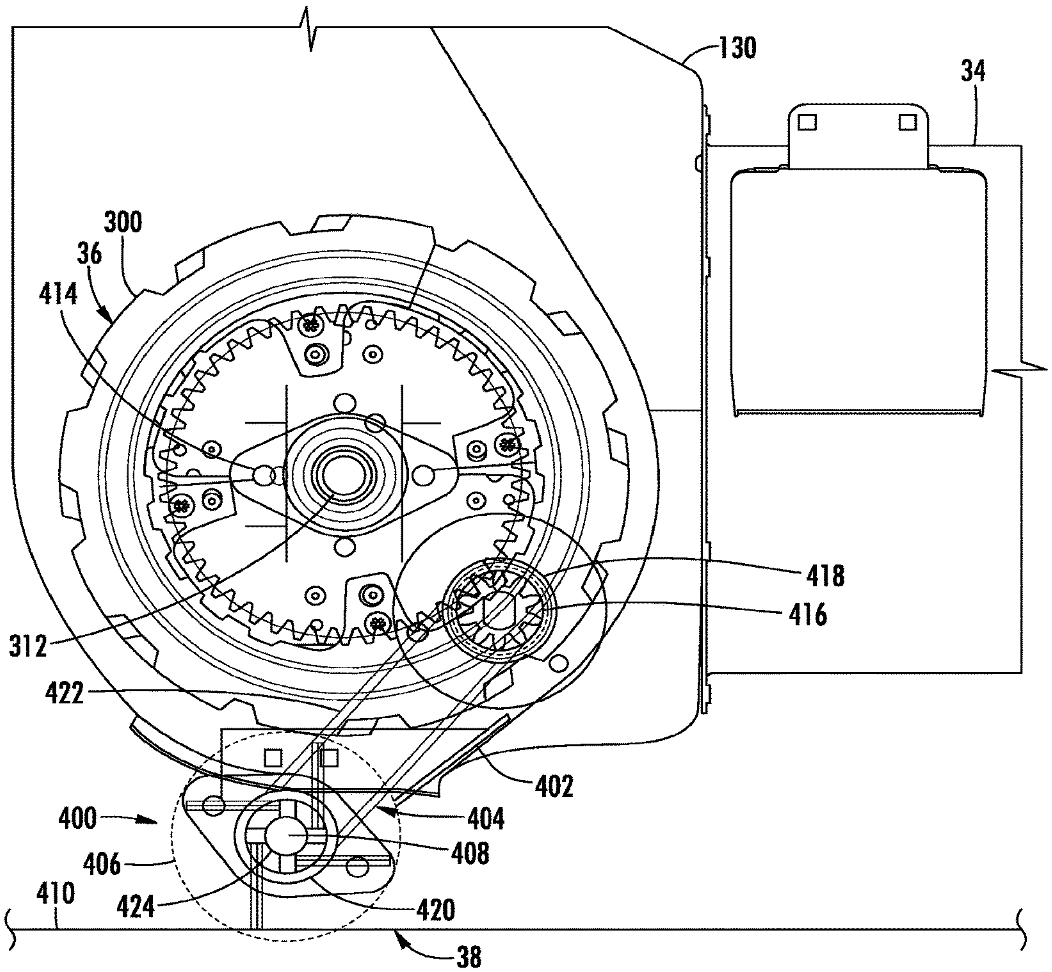
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FIG. 12

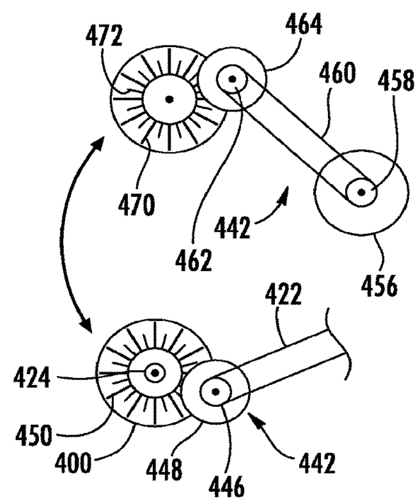
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FIG. 15

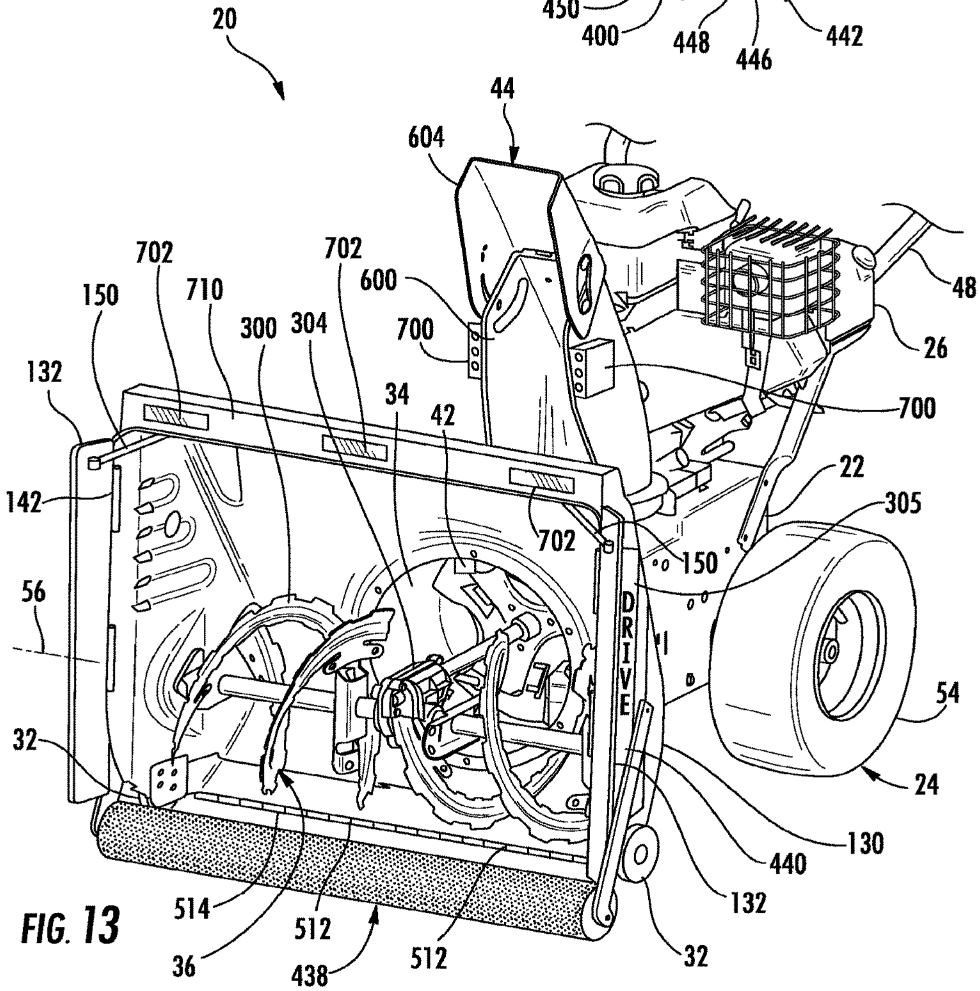
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FIG. 13

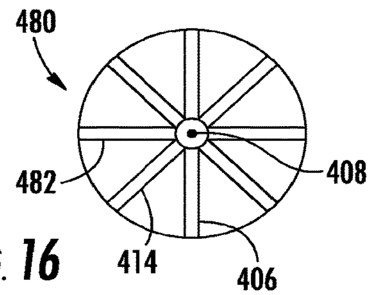
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FIG. 16

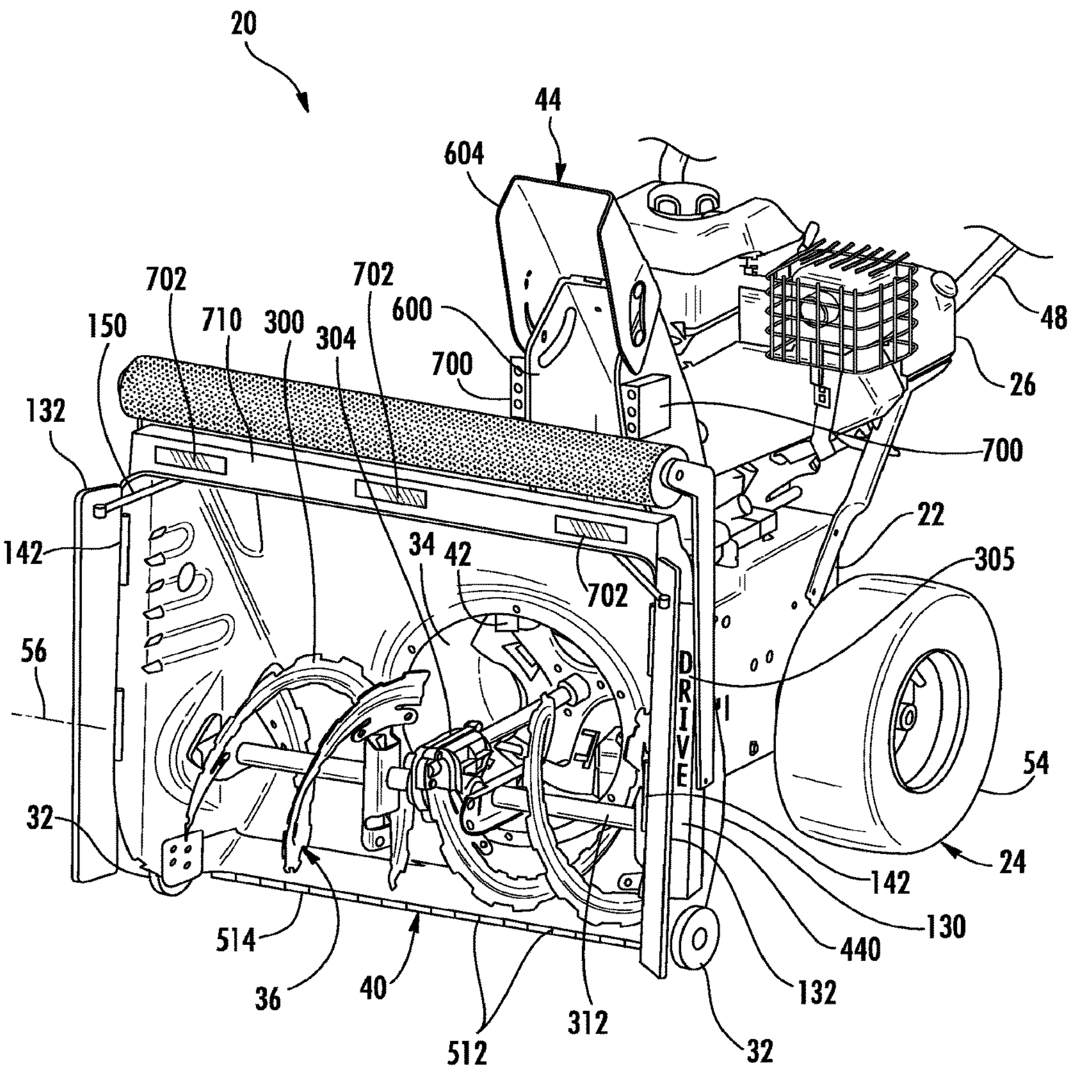
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FIG. 14

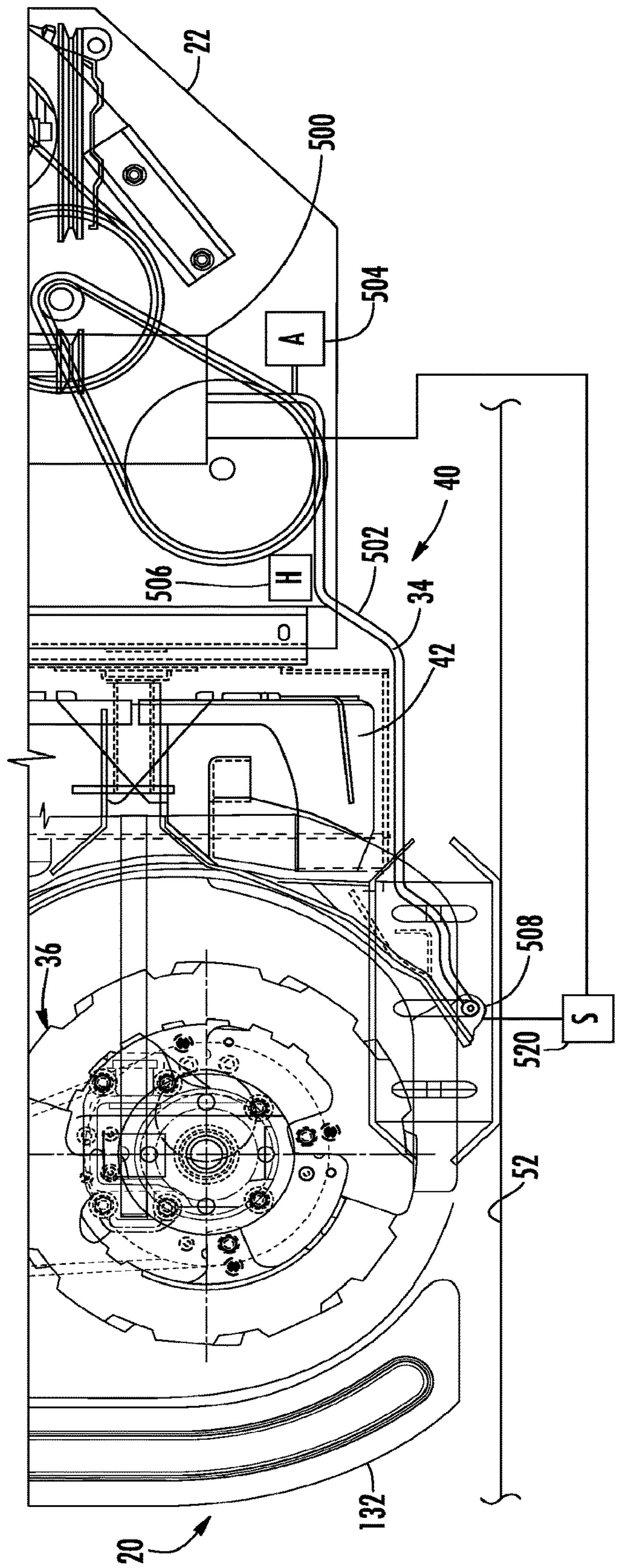

FIG. 17

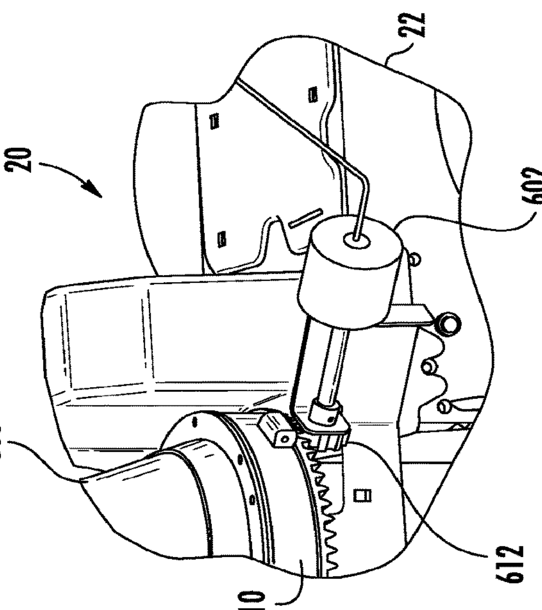
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FIG. 19

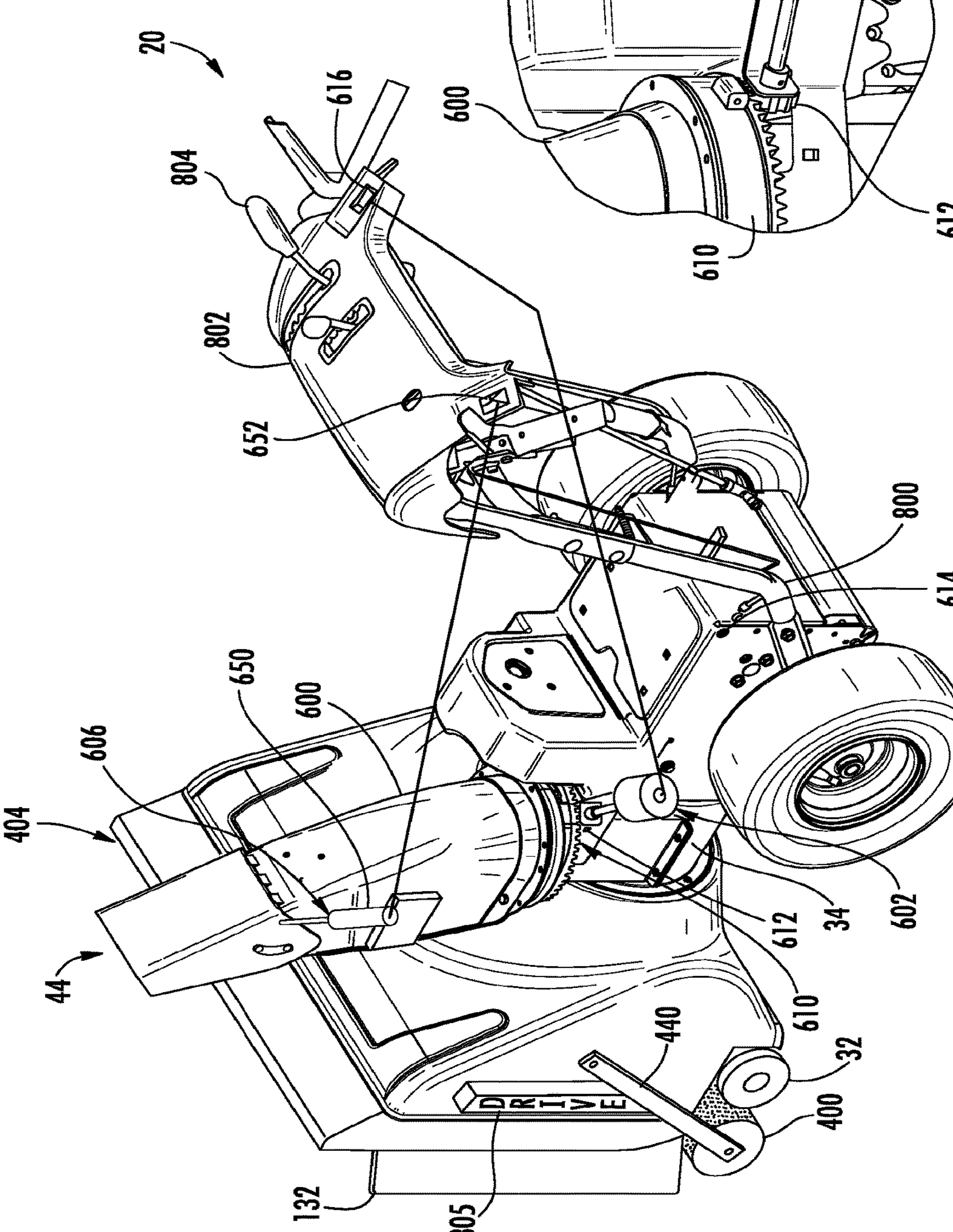
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FIG. 18

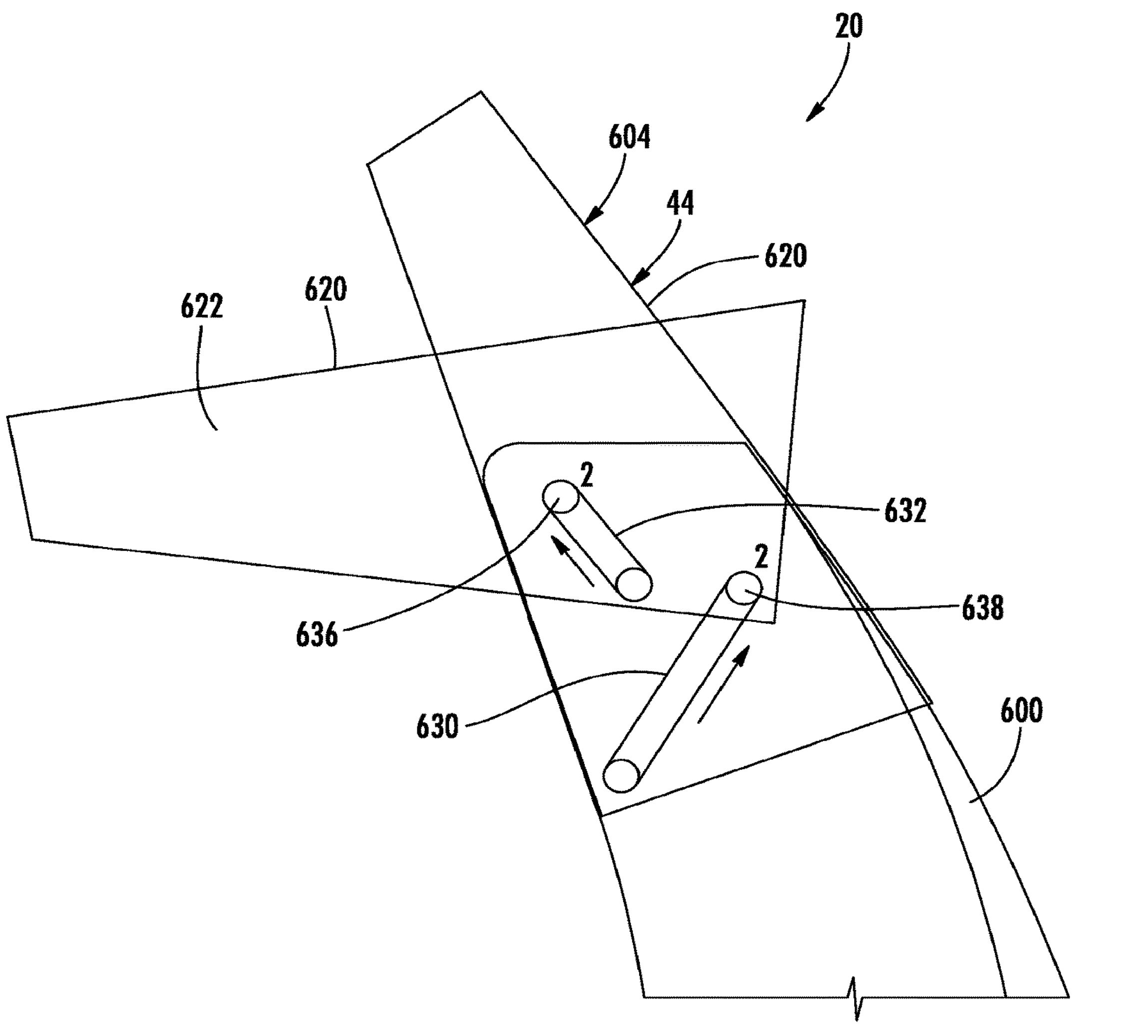

FIG. 20

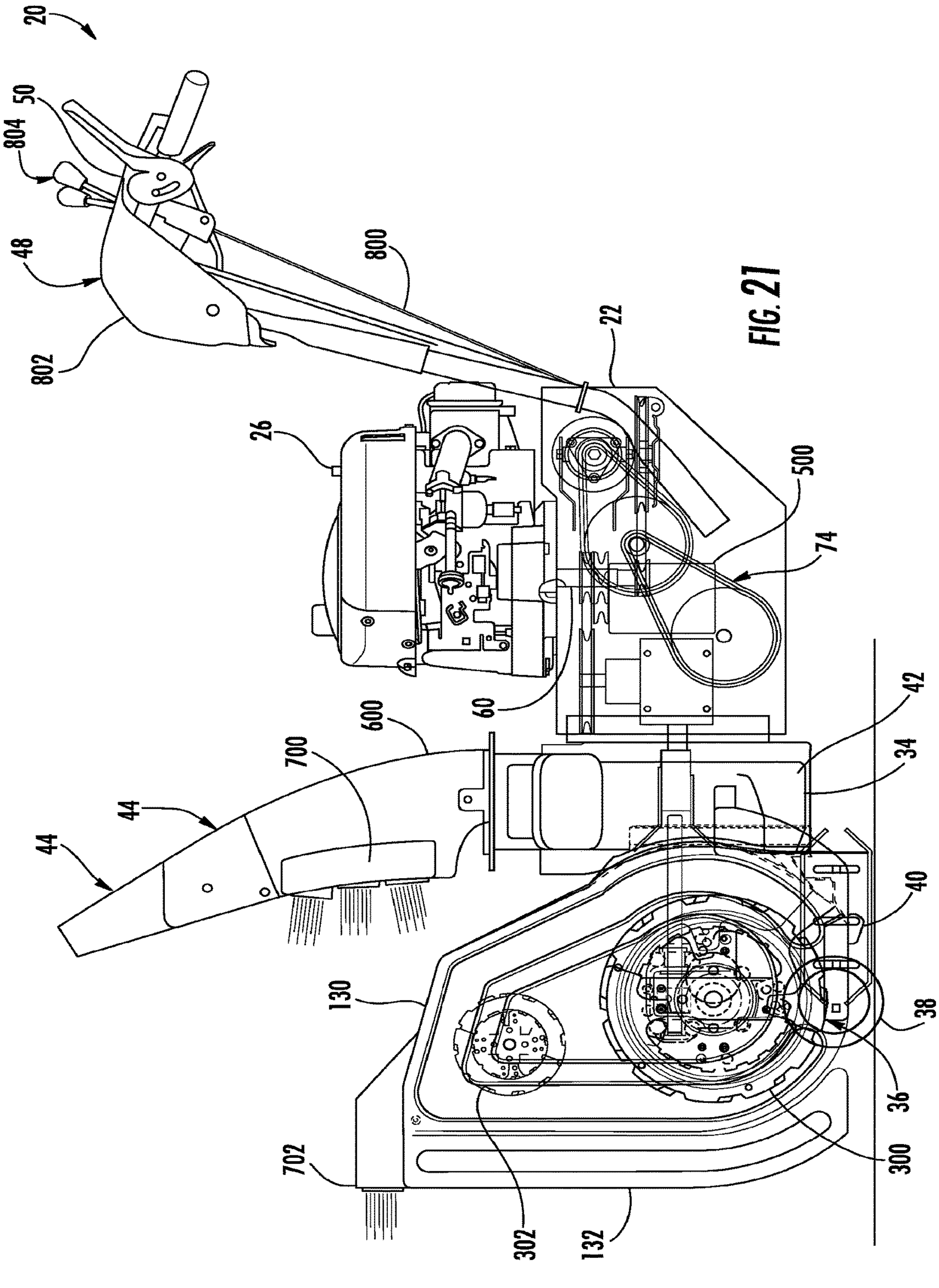
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FIG. 21

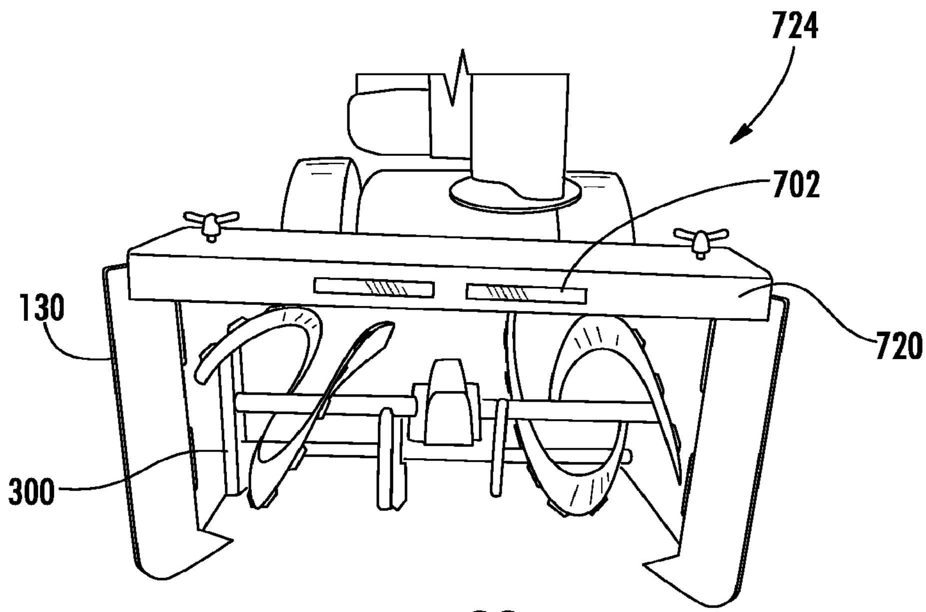

FIG. 22

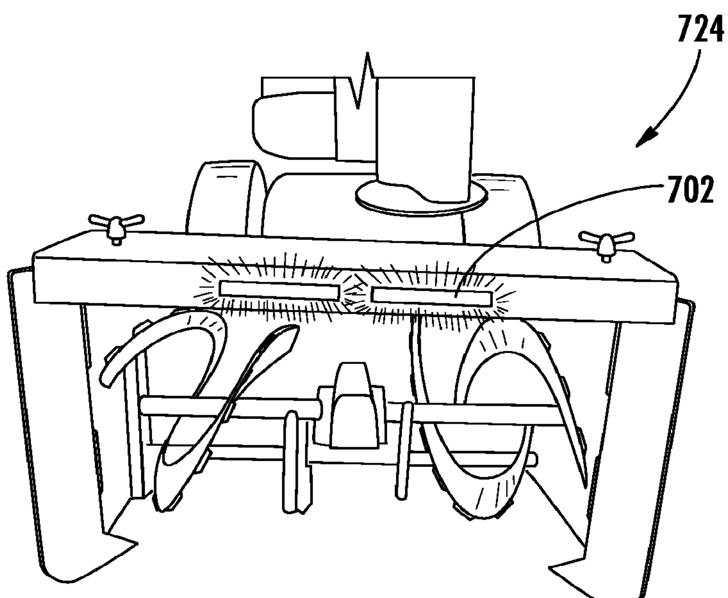

FIG. 23

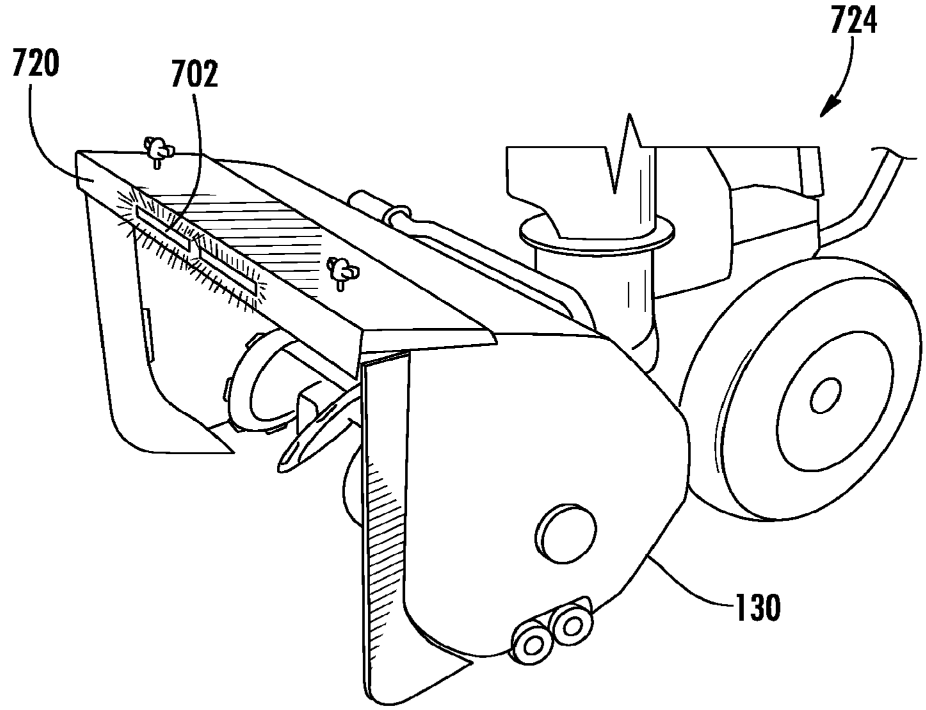

FIG. 24

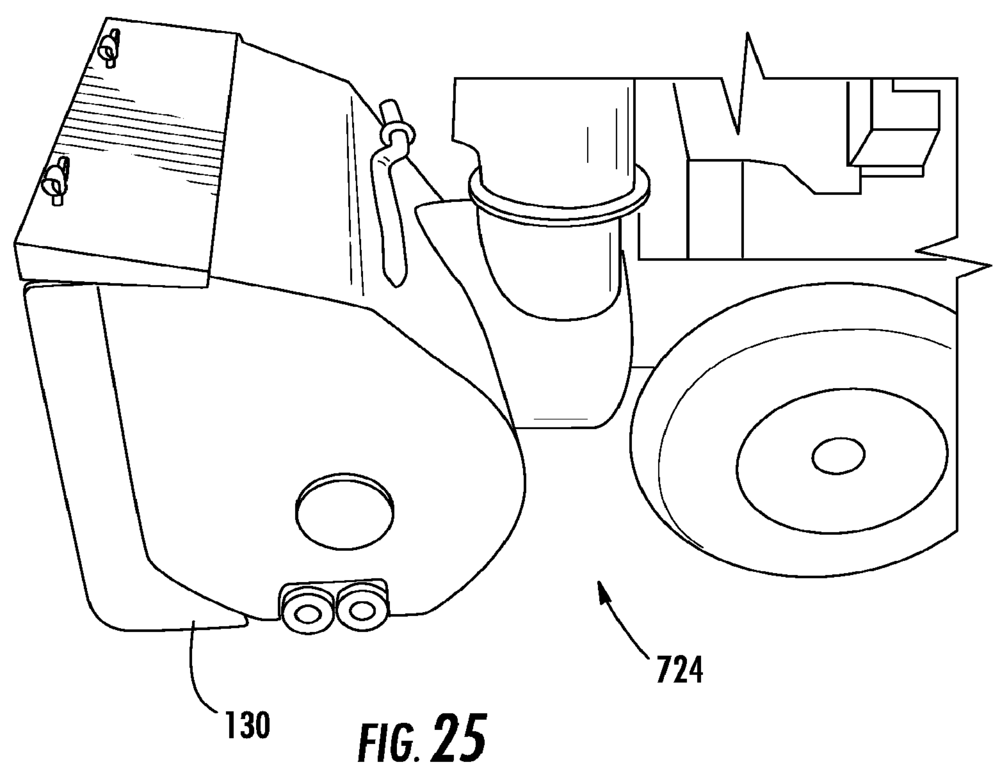

FIG. 25

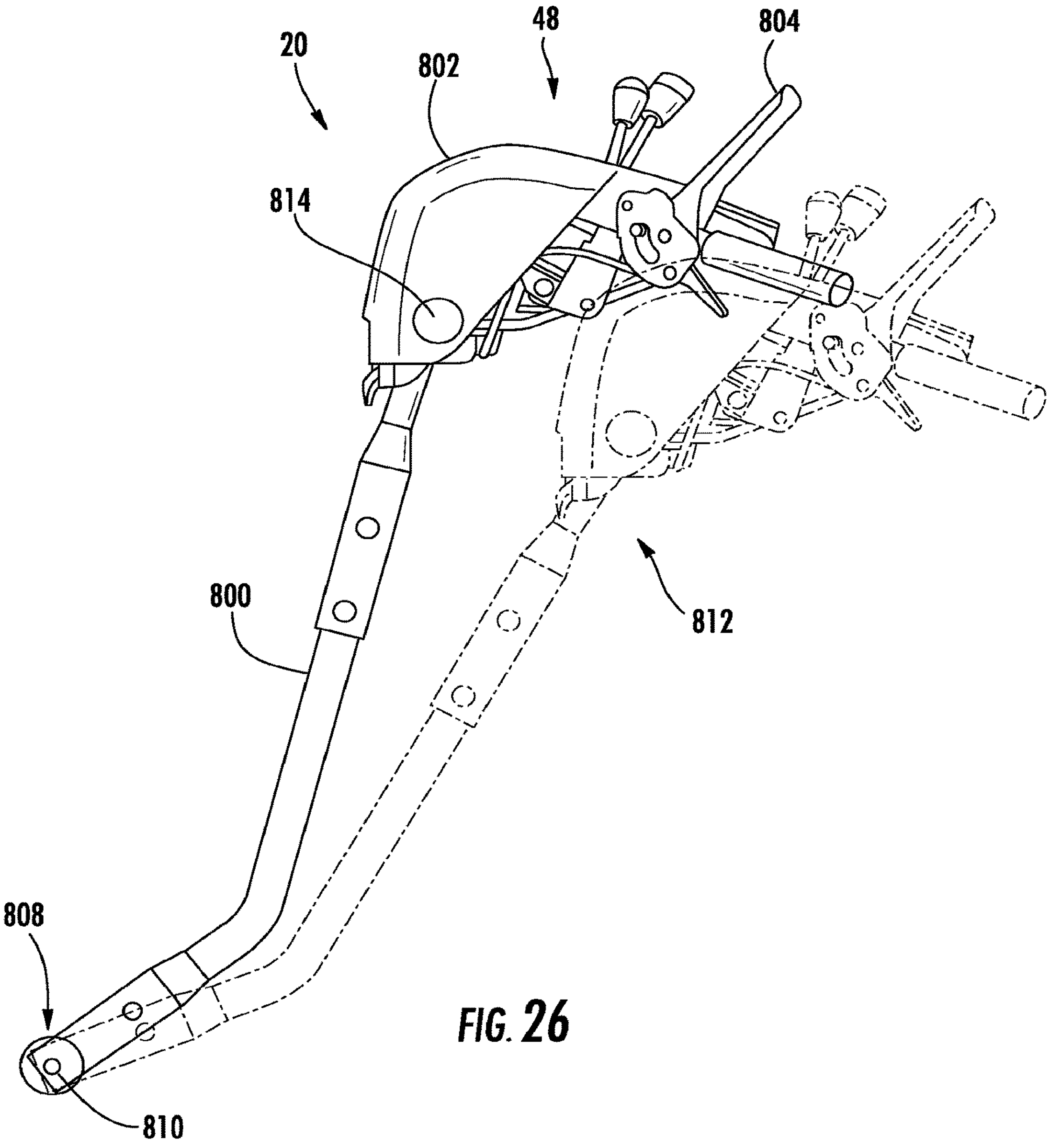

FIG. 26

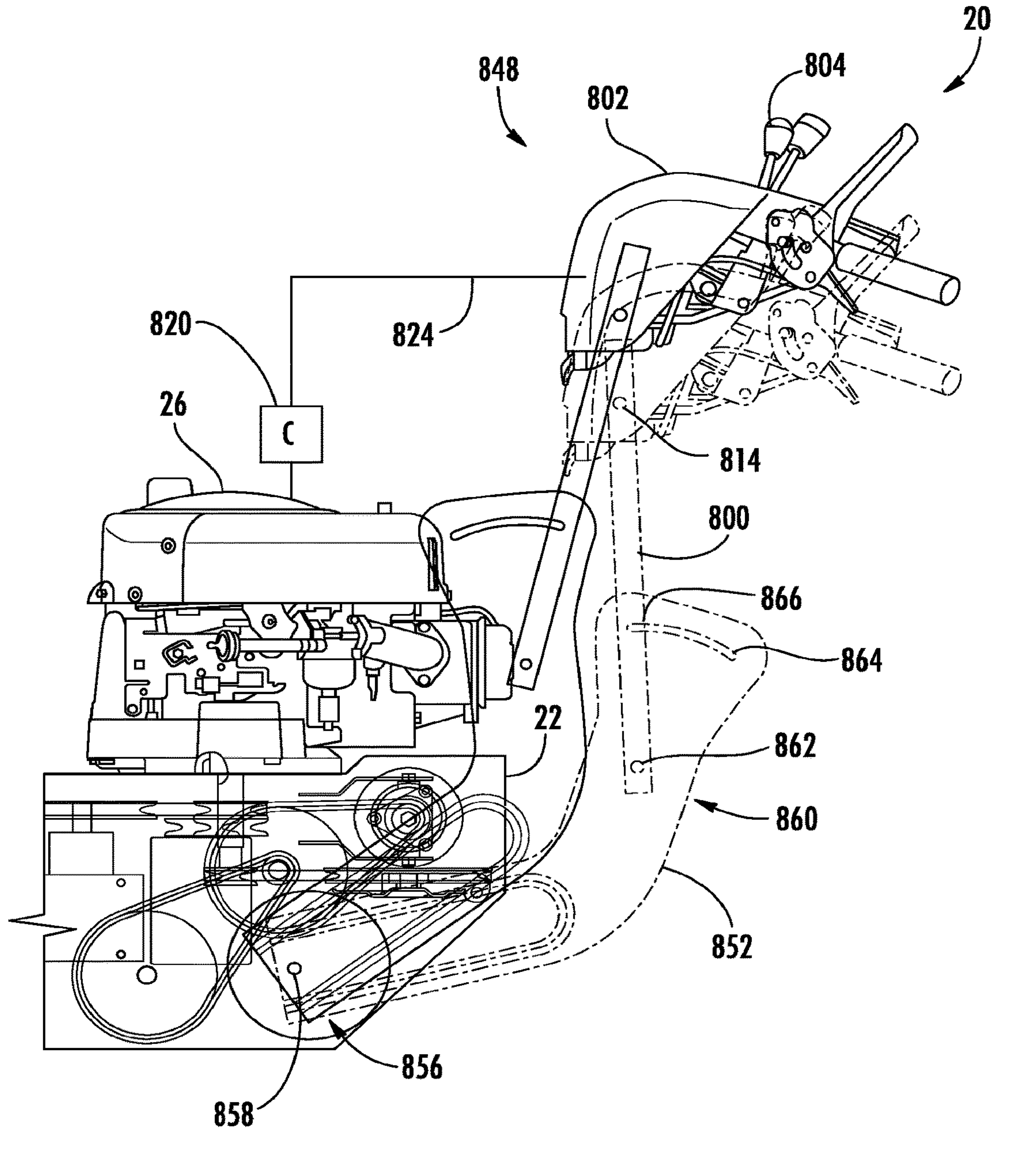

FIG. 27

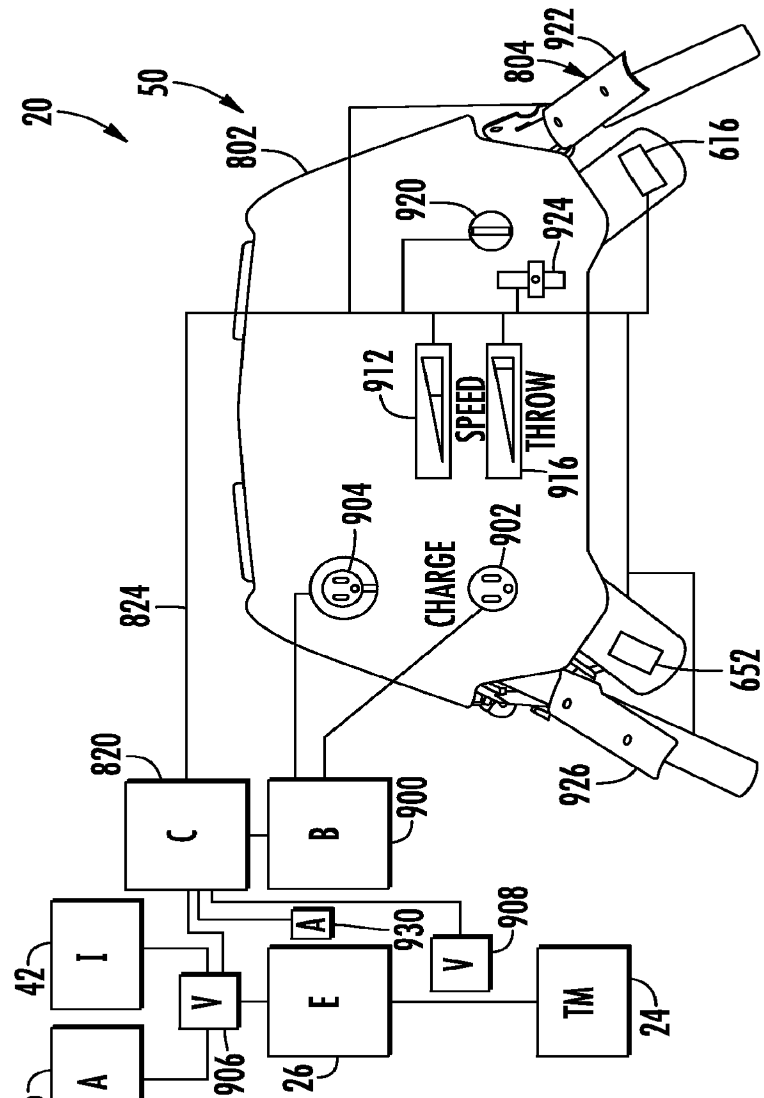
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FIG. 28

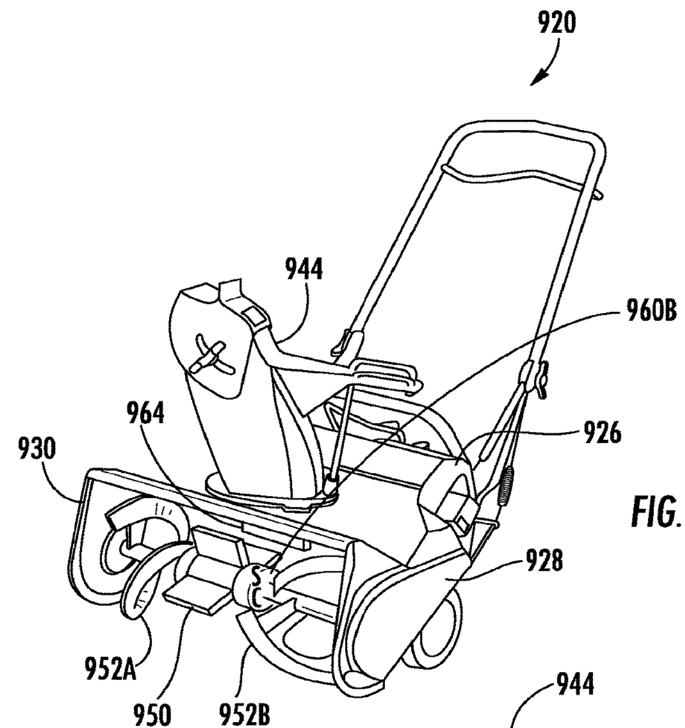

FIG. 29

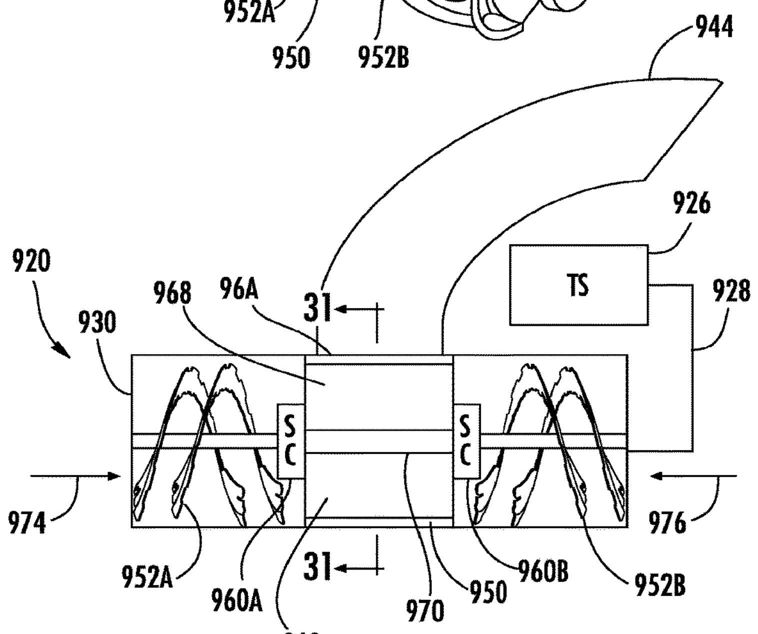

FIG. 30

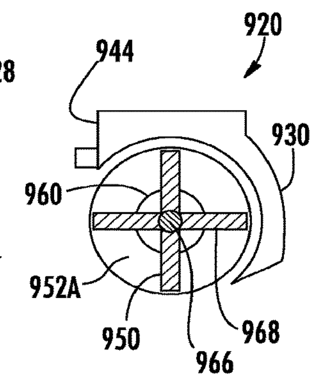

FIG. 31

SNOW THROWER

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 15/451,388, filed Mar. 6, 2017, which is a continuation of U.S. application Ser. No. 14/540,574, filed Nov. 13, 2014, which is a continuation of PCT/US2013/040952, filed May 14, 2013, which claims the benefit of U.S. Application No. 61/647,056, filed May 15, 2012, all of which are incorporated herein by reference in their entireties.

BACKGROUND

[0002] Single-stage snow throwers utilize a single impeller to both cut through snow and discharge the snow through a chute. Existing single-stage snow throwers experience difficulties with large amounts of snow or hardened snow. Two-stage snow throwers cut the snow in a first stage with an auger and transfer the snow to an impeller which discharges the snow through the chute in a second stage. Existing two-stage snow throwers may not adequately handle deep snow, may not adequately clean hardened snow from the underlying terrain, may utilize complex and expensive transmissions and may be difficult to operate.

SUMMARY

[0003] One embodiment of the invention relates to a snow thrower including an auger housing, a center snow impelling blade housed within the auger housing, a first blade positioned on a first side of the center snow impelling blade and configured to be driven about a rotational axis of a drive shaft, and a second blade positioned on a second side of the center snow impelling blade and configured to be driven about the rotational axis of the drive shaft. The first blade and the second blade are housed within the auger housing and configured to drive snow to the center snow impelling blade. The auger housing directs snow to the center snow impelling blade, the first blade, and the second blade.

[0004] Another embodiment of the invention relates to a snow thrower including an auger housing and an auger assembly housed within the auger housing. The auger assembly includes a center snow impelling blade rotating about a rotational axis of a drive shaft and having one or more paddles extending radially outward from the rotational axis, a first helical blade positioned on a first side of the center snow impelling blade, and a second helical blade positioned on a second side of the center snow impelling blade. The first helical blade and the second helical blade are configured to be driven about a rotational axis of the drive shaft to drive snow to the center snow impelling blade. At least one portion of the one or more paddles is offset from the rotational axis.

[0005] Alternative exemplary embodiments relate to other features and combinations of features as may be generally recited in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The disclosure will become more fully understood from the following detailed description, taken in conjunction with the accompanying figures, wherein like reference numerals refer to like elements, in which:

[0007] FIG. **1** is a side view of an example snow thrower with portions transparently shown.

[0008] FIG. **2** is a side view of an example transmission of the snow thrower of FIG. **1** with portions transparently shown.

[0009] FIG. **3** is a side view of an example adjustable auger housing of the snow thrower of FIG. **1** with portions transparently shown.

[0010] FIG. **4** is a top plan schematic view of the adjustable auger housing of FIG. **3**.

[0011] FIG. **5** is a front view of the adjustable auger housing of FIG. **4**.

[0012] FIG. **6** is a side view of an example housing support disc system of the snow thrower of FIG. **1** with portions transparently shown.

[0013] FIG. **7** is a fragmentary front view of the housing support disc system of FIG. **6** with portions transparently shown.

[0014] FIG. **8** is a front perspective view of an example implementation of the housing support disc system of FIG. **6**.

[0015] FIG. **9** is another front perspective view of the housing support disc system of FIG. **8**.

[0016] FIG. **10** is a side view of an example auger system of the snow thrower of FIG. **1** with portions transparently shown.

[0017] FIG. **11** is a front perspective view of the snow thrower of FIG. **1**.

[0018] FIG. **12** is a side view of an example sweeper system of the snow thrower of FIG. **1** with portions transparently shown.

[0019] FIG. **13** is a front perspective view of the snow thrower a FIG. **1** including another example sweeper system in a lowered state.

[0020] FIG. **14** is a front perspective view of the snow thrower of FIG. **12** with the sweeper system in a raised state.

[0021] FIG. **15** is a side view of another example sweeper of the sweeper system of FIG. **13**, illustrating movement of a sweeper between raised and lowered positions.

[0022] FIG. **16** is a side view of another example sweeper of the sweeper system of FIG. **13**.

[0023] FIG. **17** is a side view of an example cutting system of the snow thrower of FIG. **1** with portions transparently shown.

[0024] FIG. **18** is a rear perspective view of the snow thrower of FIG. **1**.

[0025] FIG. **19** is a fragmentary perspective view of the snow three of FIG. **1** illustrating an example chute assembly.

[0026] FIG. **20** is a side view of an example chute of the assembly of FIG. **19** with portions transparently shown to illustrate movement of the chute between two positions.

[0027] FIG. **21** is a side view of the snow thrower of FIG. **1** illustrating an example lighting system.

[0028] FIG. **22** is a front view of the snow thrower of FIG. **21**.

[0029] FIG. **23** is another front view of the snow for of FIG. **21**.

[0030] FIG. **24** is a front perspective view of the snow thrower of FIG. **21**.

[0031] FIG. **25** is a another front perspective view of the snow third of FIG. **21**.

[0032] FIG. **26** is a side view illustrating an example handle arrangement of the snow thrower FIG. **1** in different positions.

[0033] FIG. 27 is a side view of the snow thrower FIG. 1 with another example handle arrangement in different positions.

[0034] FIG. 28 is a schematic diagram of an example control system of the snow thrower a FIG. 1.

[0035] FIG. 29 is a front perspective view of another example snow thrower.

[0036] FIG. 30 is a front view of the snow thorough FIG. 29 with portions schematically shown.

[0037] FIG. 31 is a sectional view of the snow thrower of FIG. 30 take along line 31-31.

DETAILED DESCRIPTION

[0038] FIG. 1 is a side elevational view of an example snow thrower 20. Snow thrower 20 provides a person with the opportunity to clear snow in an easier and more cost-effective manner. Snow thrower 20 generally comprises a frame 22, traction members 24, vertical shaft engine 26, transmission 28, adjustable auger housing system 30, housing support disc systems 32, impeller housing 34, auger system 36, sweeping system 38, cutting system 40, impeller 42, chute assembly 44, lighting system 46, handle arrangement 48 and control system 50.

[0039] Frame 22 comprises one or more brackets, plates, bars, frames or other structures which support remaining components of snow thrower 20. Traction members 24 comprise members movably supported in engagement with the underlying terrain 52 which are configured to engage in provide traction for movement along terrain 52. For purposes of this disclosure, the phrase "configured to" denotes an actual state of configuration that fundamentally ties the stated function/use to the physical characteristics of the feature proceeding the phrase "configured to". In the example illustrated, traction members 24 comprise wheels 54 rotatable about a traction axis 56. In one implementation, traction members 24 are rotationally driven by engine 26. In other implementations, traction members 24 may be manually pushed. In other implementations, traction members 24 may comprise wheels that drive endless tracks or other terrain engaging members.

[0040] Vertical shaft engine 26 comprises a vertical shaft engine supported by frame 22 and operably coupled to traction members 24 by traction or friction drive 28. Transmission 28 receives torque from a vertical output shaft 60 from engine 26 and transmits such torque to drive traction members 54 as well as auger system 36. FIG. 2 is an enlarged view illustrating transmission 28. As shown by FIG. 2, transmission 28 comprises pulley 62, belt 63, pulley 64, friction plate or disc 66, support 68, bias 70, friction wheel 72, speed reducer 74, pulley 76, pulley 78, belt 80 and right angle gear drive 82. Pulley 62 is operably coupled to vertical output shaft 60 of engine 26 and drives belt 63 which wraps about pulley 64. Pulley 64 is fixed to friction disk or plate 66 to rotationally drive the friction disk or plate 66 about vertical axis 86 which is rotationally supported by support 68. In some implementations, plate 66 may be provided as part of pulley 64. Support 68 pivots about axis horizontal axis 70 to move friction plate 66 between an engaged position in engagement with friction wheel 72 and a retracted or withdrawn position out of engagement with friction wheel 72. Support 68 supports plate 66 below friction wheel 72 while bias 70 resiliently biases support 68 and plate 66 upward towards the engaged position. In the example illustrated, bias 70 comprises a torsion spring.

[0041] In other implementations, bias 70 may comprise other springs for resiliently biasing support 68 and plate 66 about a horizontal pivot axis. In some implementations, bias 70 may be omitted, wherein belt 63 solely supports plate 66 in the engaged position. In yet other implementations, friction plate 66 may be vertically movable upward into engagement with wheel 72 or vertically movable downward out of engagement with wheel 72 in other fashions other than through pivotal movement.

[0042] Friction wheel 72 comprises a wheel having an outer circumferential edge of frictional contact in engagement with friction plate 66 when friction plate 66 is rotationally supported in the engaged position by support 68. Friction wheel 72 engages friction plate 66 at one or more locations eccentric to the rotational axis 86 of plate 66. Friction wheel 72 receives and transmits torque from friction plate 66 to speed reducer 74.

[0043] Friction wheel 72 and friction plate 66 cooperate to form a friction drive. In the example implementation illustrated, the friction drive formed by the interaction or friction joint between plate 66 and wheel 72 is located rearward of traction axis 56 and nominally rearward of the vertical shaft of engine 26. In the example implementation illustrated, the friction drive is additionally located vertically above traction axis 56. As a result of its location, the friction drive provided by friction wheel 72 and friction plate 66 is distant impeller housing 34 and chute assembly 44. Rather than being located proximate to impeller housing 34 and chute assembly 44, the friction drive is substantially isolated from the introduction of moisture by snow and ice or other the introduction of other contaminates. As a result, a dry clean environment for the friction drive is facilitated with a reduced reliance upon complex and costly moisture sealing structures, such as rubber gaskets and the like.

[0044] Because friction plate 66 moves or swings wings upwardly into engagement with friction wheel 72, in cases a failure, such as failure of belt 63, support 68 may fall under the force of gravity against the bias to reposition friction plate 66 out of frictional contact with wheel 72. As a result, this arrangement facilitates an enhanced automatic disengagement of the drive driving traction members 54 in response to belt or other failures. In other arrangements, friction plate 66 may alternatively be located above friction wheel 72.

[0045] Speed reducer 74 transmits torque from friction wheel 72 to an axle of traction members 54 about traction axis 56 while reducing the speed of such rotational motion. In the example illustrated, speed reducer 74 comprises a set of speed reducing pulleys and belts, pulleys 90, 94, 96, 98 and belts 100, 102. In other implementations, sprocket and chain arrangements or gear trains may alternatively be utilized for speed reducer 74 or in place of and the other arrangements wherein belt and pulleys are disclosed.

[0046] Pulley 76, 78, belt 80 and right angle gear box 82 cooperate to transmit torque from output shaft 60 to other implements, such as auger system 36 and impeller 42. Pulley 76 is operably coupled to output shaft 60 and is connected to pulley 78 by belt 80. Pulley 78 is fixed to an input shaft 104 of right angle gear box 82. Right angle gear box 82 comprises series of gears whereby torque about a vertical axis is converted to torque about a horizontal axis, such as through the use of a pair of bevel gears (not shown). Torque from right angle gear box 82 is discharged through a horizontal output shaft **106** which is operably coupled to auger system **36** and impeller **42**.

[0047] FIGS. **3-5** illustrate adjustable auger housing system **30**. Adjustable auger housing system **30** houses auger system **36** and direct snow to auger system **36**. Adjustable auger housing system **30** comprises a main housing **130**, wings or extensions **132** and retainers **134**. Main housing **130** partially enclose and extends about at least one rotatable snow moving member, such as an auger as with a two-stage or three stage snow thrower or an auger/impeller as with a one stage snow thrower. In the example illustrated, main housing **130** houses auger system **36**, part of a 2+ stage snow thrower. Auger housing **130** directs snow to auger system **36** which move such snow to impeller **42**. In one implementation, auger housing **130** comprises a single integral structure integrally formed as a single unitary body of a single sheet or layer of material that is deformed or deep drawn. In other implementations, auger housing **130** may be formed from multiple structures which are welded, fastened or otherwise joined to one another.

[0048] Wings or extensions **132** comprise elongate flaps or panels pivotably coupled to main auger housing **130** on opposite sides of a mouth **138** of housing **130** for pivotal movement about axes **140** defined by hinges **142**. As shown by FIGS. **4** and **5**, extensions **132** pivot between a first narrow position **144** shown in solid lines and a second extended or mouth widening position **146** shown in broken lines. In the mouth widening position **146**, extensions **132** and large the size of mouth **138** to capture and direct a greater width of snow. In one implementation, the mouth widening position **146** increases a width W on each side by at least 1 inch and nominally 2 inches, enabling the entire with of mouth **138** to be increased by at least 2 inches and nominally 4 inches. At the same time, repositioning of extensions **132** to the narrow position **144** decreases the width of mouth **138** when it is desirable to reduce a rate at which snow is captured and directed to augers, such as when the snow is deeper or heavy (wet). Reposition extension **132** to the narrow position **144** further reduces the width of mouth **138** and auger housing **30** for reduced consumption of space when in storage. In the example illustrated, pivotal movement of extensions **132** is independent; one extension **132** may be extended while the other extension **132** is retracted.

[0049] Retainers **134** secure and retain extensions **132** and at least either of positions **144**, **146**. In one implementation, retainers **134** are configured to secure and retain extensions **132** and any of continuum of intermediate locations or positions between positions **144**, **146**. In the example implementation shown in FIGS. **4** and **5**, each retainer **134** comprises retaining plate **150**, links **151** and retaining pin **152**. Retaining plate **150** comprise a plate slidably supported along housing **130** by grooves, tracks or other guiding structures for movement between a first position shown in solid lines and a second extended position shown in broken lines. Links **151** comprise members pivotally connected at one end to extension **132** and at another end to plate **150** such that movement of extension **132** from the extended position **146** to the narrow position **144** slides plate **150** from the first position to the second extended position and vice versa.

[0050] Retaining pin **152** of each actuator **134** comprises a pin movable between a plate engaging position in which pin **162** engages plate **152** inhibit movement of plate **150** and a withdrawn position or disengaged position allowing plate **152** be moved. In one implementation, pin **152** comprises a threaded shaft or pin threadably engaging a threaded bore, allowing pin **152** to be rotated between engaging position in the disengaged position. In another implementation, pin **152** may be resiliently biased by spring towards the engaging position, allowing a person to pull pin **152** against the bias to the withdrawn or disengaged position. In one implementation, pin **152** has an axial end which frictionally engages a face of plate **150**. In another implementation, pin **152** projects partially into a depression or detent in plate **150**. In yet another implementation, the detent comprises a hole or opening extending completely through plate **150**, wherein pin **152** projects through the hole when in the engaged position.

[0051] In still other implementations, other retaining mechanisms may be used to selectively retain each extension **132** in either the narrow or mouth widening positions. For example, in other implementations, a powered actuator may be used to selectively move extension **132** between positions **144**, **146** and to selectively retain extensions **132** between the positions **144**, **146**. In one implementation, an electric solenoid may have a first end pivotally connected to housing **130** and a second end pivotally connected to an extension **132** to selectively move and retain the extension **132**. In another implementation, a hydraulic or pneumatic piston-cylinder assembly may have a first and pivotally connected to housing **130** and a second end pivotally connected to an extension **132** to selectively move and retain the extension **132**. In yet another implementation, such actuation and retention may be provided by a motor that rotatably drives a worm screw or threaded rod pivotably attached to extension **132** to pivot extension **132**.

[0052] FIGS. **6** and **7** illustrate one of housing support disc systems **32** in more detail. An example illustrated, snow thrower **20** includes two housing support disc systems **32**, one on each side. In other implementations, snow thrower **20** may include more than one housing support disc systems **32** on each side. As shown by FIGS. **6** and **7**, each of housing support disc systems **32** comprises a rotatable disc **232** rotationally coupled to housing **130** for rotation about axis **234**. Disc **232** has an outer circumference **236** thinning below or lower than a bottom **238** of housing **130**. Disc **232** is configured to at least partially cut through or slice through packed snow, allowing snow thrower **20** to better remove packed snow and to inhibit housing **130** from undesirably riding up on such packed snow. At the same time, disc **232** rotates to reduce resistance to forward movement of snow thrower **20**.

[0053] In one implementation, disc **232** has at least an outer circumferential edge **236** that is sufficiently soft so as to not score underlying concrete or pavement. For example, in one implementation, disc **232** has an outer circumferential edge **236** having a polymeric surface. In one implementation, edge is formed from a high density polyethylene. In yet other implementations, an entirety of disc **232** may be formed from such a polymeric material, such as a high density polyethylene. In yet other embodiments, disc **232** may be formed from other materials or may have different degrees of sharpness to cut through packed snow while avoiding scoring of underlying pavement or concrete.

[0054] In one implementation, disc **232** has a thickness of less than or equal to 0.5 inches along the outer circumferential edge **236**. In one implementation, disc **232** has a uniform radial thickness. In another implementation, disc **232** tapers towards circumferential edge **236** to better facilitate cutting through packed snow. In yet other implementations, disc **232** may include multiple parallel blades or discs or may have other configurations.

[0055] In one implementation, each disc **232** is supported at an adjustable height with respect to a bottom **238** of housing **130**. In other words, each disc **232** is adjustable to one of a plurality of available positions. In the implementation shown in FIG. **6**, disc **232** is rotatably supported and carried by a support bracket **240** which is itself movably coupled the housing **130**. In the example illustrated, support bracket **240** includes a pair of spaced slots **244** with a fastener **246** (a bolt) extending through each slot and a return **44** (one of which is shown) and through a corresponding opening within housing **130**, wherein a not secures the bolt in place to retain support bracket **240** and a selected position with respect to housing **130** to support disc **232** at a selected height with respect to housing **130**. In other implementations, support bracket **244** may be selectively secured at different positions with respect to housing **130** by other fasteners and other adjustable mounting mechanisms. In still other implementations, disc **232** may be directly secured to housing **130** in a manner to allow adjustable repositioning. For example, disc **232** may include a bolt which selectively positioned within an elongate slot formed within housing **130** and held in place by an associated nut.

[0056] FIGS. **8** and **9** illustrate housing support disc system **252**, a particular example implementation of housing support disc system **32**. Housing support discs system is similar to housing support discs system **32** except that housing support discs system **252** includes housing support disc **262** in place of disc **232**. In the example illustrated, disc **262** comprises a washer rotatably supported by bracket or support **240** at one of a plurality of different positions with respect to housing **130**. In other implementations, housing support discs system **252** may have other configurations.

[0057] As shown by FIG. **1**, impeller housing **34** comprises a cylindrical structure, sometimes referred to as an impeller can, connected to a rear of auger housing **30** for receiving snow from auger assembly **36**. Impeller housing **34** surrounds and encloses impeller **42** and includes an outer opening through which snow is directed by impeller **42** into and through chute assembly **44**.

[0058] Auger assembly or system **36** comprises an arrangement of one or more augers to break apart snow and direct such snow into impeller housing **34** for further impelling by impeller **42**. In the example illustrated, auger assembly **36** provides for two levels of snow collection and breakup. As best shown by FIG. **10**, auger system **36** is largely contained within auger housing **130** and comprises a main auger **300**, auxiliary auger **302**, auger gearbox **304**, and auxiliary auger drive **305** (schematically shown in FIG. **11**) provided by pulleys **306**, **308** and belt **310**. Main auger **300** comprises a helical blade or series of blades rotatable about axis **312** so as to breakup snow and direct such snow towards a central opening where it may flow into impeller can or impeller housing **34**.

[0059] FIG. **11** is a front perspective view of snow thrower **20**, with some portions omitted to better illustrate other portions of snow thrower **20**. FIG. **11** illustrates auger system **36** with auxiliary auger **302** and the auxiliary auger drive provided by pulleys **306**, **308** and belt **310** being omitted. As shown by FIG. **11**, the lower main auger **300** comprises multiple helical flights mounted to form a composite helical auger blade. In other implementations, floor main auger **300** and be formed as a single blade or may have other configurations.

[0060] In the example illustrated, main auger **300** has an outer diameter that is less than an outer diameter of impeller **42**. In one implementation, auger **300** has a diameter of less than or equal to 12 inches. Because main auger **300** has an outer diameter that is less than the outer diameter of impeller **42**, main auger housing **130** may be shallower, facilitating the formation of auger housing **130** from a single deep drawn sheet of material while at the same time maintaining the diameter of impeller **42** to maintain the snow throwing distance of snow thrower **20**.

[0061] As shown by FIG. **10**, auxiliary auger **302** comprises one or more structures forming one or more helical blades that are rotatably supported by housing **130** above main auger **300**. Auxiliary auger **302** rates of snow above the lower main auger **300**. Like main auger **300**, auxiliary auger **302** channels snow towards the center of housing **130** and into impeller housing **34**. As a result, augers **300**, **302** facilitate more efficient movement of deep snow.

[0062] In the example illustrated, auxiliary auger **302** has a diameter smaller than the diameter of auger **300**. In other implementations, auger **302** may have a diameter the same are larger than the diameter of auger **300**. In the example illustrated, auger **302** rotates in the same direction as auger **300**, clockwise as seen in FIG. **10**. In other implementations, auger **302** may rotate in opposite direction as compared to auger **300**, in a counter clockwise direction as seen in FIG. **10**. In yet other implementations, auxiliary auger **302** and its drive may be omitted.

[0063] Auxiliary auger drive **305**, provided by pulleys **306**, **308** and belt **310**, transmits torque from horizontal shaft driving main auger **300** to the horizontal shaft supporting auxiliary auger **302** to drive auxiliary auger **302**. In the example illustrated, torque is transmitted to main auger **300** by auger gearbox **304** located at a center point of main auger **300**. Pulley **306** is fixed to a center shaft **312** of main auger **300** outside of auger housing **130** along a side of auger housing **130** to rotate with shaft **312**. Pulley **308** is fixed to a center shaft or drive shaft **314** of auxiliary auger **302** outside of auger housing **130** along the same side of auger housing **130** as pulley **306**. Belt **310** wraps about pulleys **306**, **308** transmits torque along the outside of auger housing **130** from shaft **312** to shaft **314**. Because auxiliary auger drive **305** transmits torque auxiliary auger **302**, separate torque sources for auxiliary auger **302** may be omitted. Because drive **305** extends along in outside of auger housing **130**, the capacity of auger housing **130** is not reduced and drive **305** is at least partially isolated from the moisture and driving forces of the snow.

[0064] In other implementations, separate sources of torque, independent of main auger **300**, may be provided for auxiliary auger **302**. In other implementations, other mechanisms may be utilized to transmit torque from main auger **300** to auxiliary auger **302**. For example, gear trains or chain and sprocket assemblies may also be utilized for transmitting torque. Although illustrated as being along an outside surface of housing **130** (contained in a shield or box), in other implementations, drive **305** may be located within a box located along an interior of housing **130**.

[0065] Sweeping system **38** comprises a mechanism configured to provide a resiliently flexible support at a front end the snow thrower **20** for engaging the terrain while resiliently adapting to minor changes in the terrain (cracks, groups, ridges and the like) and for cleaning snow down to the terrain surface. As shown by FIG. **12**, sweeping system **38** comprises sweeper **400**, scraper bar **402** and sweeper drive **404**.

[0066] Sweeper **400** comprises a member which rotates about axis **408** below the rotational axis of main auger **300**. Sweeper **400** has resiliently bendable, flexible or deformable extensions **406** that radially extend away from the rotational axis **408** of sweeper **400** into engagement with the underlying terrain. Such extensions **406** scrape or brush against the underlying terrain **410** to support auger housing **130** above the terrain. Such extensions resiliently flex or deform when encountering irregularities in terrain **410**, such as cracks, bumps, ridges and the like to conform to such irregularities for removing snow from against such irregularities while also reducing sharp jolts which might otherwise occur when auger housing **130** would otherwise bump into such irregularities. In one implementation, such extensions **406** comprise tines or bristles. In another implementation, extensions **406** comprise flexible or deformable paddles.

[0067] Scraper bar **402** comprises a blade, edge or panel adjacent sweeper **400** rearward of the rotational axis **408** of sweeper **400**. Scraper bar **402** engages sweeper **400** proximate to an outer circumferential perimeter of sweeper **400**. Scraper bar **402** removes snow from sweeper **400** and directs such snow into auger housing **130**. Scraper bar **402** inhibits recirculation the snow back to terrain **410**. In other implementations, scraper bar **402** may be omitted.

[0068] Sweeper drive **404** rotationally drives sweeper **400** about axis **408**. In the example illustrated, drive **404** rotates sweeper **400** in a clockwise direction while main auger **300** is driven in a counter clockwise direction. Sweeper drive **404** comprises auger driven gear **414**, driven gear **416**, pulley **418**, pulley **420** and belt **422**. Auger driven gear **414** comprises a gear fixed to center shaft **312** of auger **300** to rotate with the rotation of center shaft **312**.

[0069] Driven gear **416** comprise a gear rotationally supported by housing **130** in meshing engagement with gear **414**. Driven gear **416** is fixed to pulley **418** so as to rotate pulley **418**. Pulley **420** is fixed to a center shaft **424** of sweeper **400**. Belt **422** wraps about and connects pulleys **418** and **420**. As a result, rotation of auger **300** also rotates sweeper **400**.

[0070] In other implementations, separate drives and separate sources of torque may be provided for sweeper **400**. In other implementations, sweeper **400** may not be driven. In other implementations, other mechanisms may be utilized to transmit torque from auger **300** to sweeper **400**. For example, a chain and sprocket arrangement or a gear train may alternatively be utilized.

[0071] FIGS. **13-15** illustrate snow thrower **20** having an alternative sweeper system **438**. Like sweeper system **38**, sweeper system **438** includes a sweeper **400** that provides a resiliently flexible support at a front end the snow thrower **20** for engaging the terrain while resiliently adapting to minor changes or irregularities in the terrain (cracks, grooves, ridges and the like) and for cleaning snow down to the terrain surface. In addition, sweeper **400** of sweeper system **438** is actuatable between a lowered state or position shown in FIG. **13** and a raised state or position shown in FIG. **14**.

[0072] In addition to sweeper **400**, sweeper system **438** comprises swing arms **440** and sweeper drive **442** (shown in FIG. **15**). Swing arms **440** comprise arms having a first end pivotally coupled or connected to opposite sides of auger housing **130** and a second end pivotally coupled or connected to opposite sides of sweeper **400**. Swing arms **440** are configured to pivot sweeper **400** between the lowered position shown in FIG. **13** in which the rotational axis sweeper **400** underlies rotational axis of auger **300** and underlies a bottom of auger housing **130** and the raised position shown in FIG. **14** in which sweeper **400** is positioned above auger housing **130** and above the mouth of auger housing **130**.

[0073] In other implementations, swing arms **440** may alternatively be configured to move sweeper **400** between lowered and raised positions at which sweeper **400** extends at other positions or locations relative to auger housing **130**. When in either the raised position or the lowered position, swing arms **440** are releasably locked or retained in place by one or more retaining mechanisms, such as a pin carried by one or both of swing arms **440** and resiliently biased towards a first detent in auger housing **130** when sweeper **400** is in the lowered position and a second detent in auger housing **130** when sweeper **400** is in the raised position. In other implementations, swing arms **440** may be pivoted by powered actuator, such as a hydraulic or pneumatic cylinder-piston assembly having one end pivotally coupled to auger housing **130** and another end coupled to swing arms **440**, wherein the powered actuator also serves to retain swing arms **440** and sweeper **400** in either the raised or lowered position.

[0074] Sweeper drive **442** rotationally drive sweeper **400**. At the same time, sweeper drive **442** permits sweeper **400** to be pivoted between the raised and lowered positions. FIG. **15** illustrates one example sweeper drive **442**. Sweeper drive **442** comprises auger gear **414** (shown in FIG. **12**), driven gear **418** (shown in FIG. **12**), belt **422**, pulley **446**, gear **448** and gear **450**. Belt **422** extends from driven gear **418** and wraps about pulley **446**. Pulley **446** is operably coupled to gear **448** to rotate gear **448**. Gear **448** has outer teeth in meshing engagement with outer teeth of gear **450**. Gear **450** is fixed to center shaft **424** of sweeper **400** such that rotation of gear **450** rotates center shaft **424** and sweeper **400**. Swinging of sweeper **400** out of the lowered position to the raised position disengages gear **450** from gear **448**.

[0075] In one implementation, sweeper drive **442** is additionally configured to rotationally drive sweeper **400** and sweeper **400** is in the raised position. For example, in some implementations such as where sweeper **400** is adjacent the mouth of auger housing **300** to contact snow and drive snow into auger housing **300**, it may be beneficial to rotationally drive sweeper **400**. In such an implementation, sweeper drive **442** may additionally comprise driven gear **456**, pulley **458**, belt **460**, pulley **462** and gear **464**.

[0076] Driven gear **456** comprises a gear rotationally supported by auger housing **130** and having teeth in meshing engagement with teeth of auger gear **414** (shown in FIG. **12**). Pulley **458** is fixed to gear **456** to rotate with gear **456**. Belt **460** wraps about pulley **458** and wraps about pulley **462**. Pulley **462** is fixed to gear **464**. Gear **464** is rotationally supported by auger housing **130** and had teeth configured to be placed into meshing engagement with teeth of gear **450** when sweeper **400** is raised and retained in the raised position. Swinging of sweeper **400** out of the race position to the lowered position disengages gear **450** from gear **464**.

[0077] Although not illustrated, in other implementations, sweeper drive **442** may include an additional gear rotationally supported by auger housing **130** between gear **464** and gear **450** when sweeper **400** is in the raised position. The additional intermediate gear, in meshing engagement both gear **464** and gear **450**, changes the direction of rotation to rotationally drive sweeper **400** in an opposite direction. In other implementations, sweeper drive **442** may have other configurations. For example, in lieu of relying upon belt and pulley arrangements, sweeper drive **442** may alternatively utilize one or more of chain and sprocket arrangements or gear trains. In some implementations, the upper portion of sweeper drive **442** may be omitted, wherein sweeper **400** merely idles when in the raised position.

[0078] FIGS. **15** and **16** further illustrate different example implementations of sweeper **400**. As shown by FIG. **15**, in one implementation, sweeper **400** comprises a cylindrical brush having tines or bristles **470**, **472**. Bristles **470** have a longer length and a lower degree of rigidity (greater flexibility) as compared to bristles **472**. Due to their greater rigidity, bristles **472** offer a greater degree of support for auger housing **130** (when sweeper **400** is in a lowered position) and offer greater ability to break up, dislodge and lift packed snow. At the same time, bristles **470**, due to their longer length and increased flexibility, offer the ability to reach into crevices and cracks to remove snow. In the example illustrated, bristles **470** and **472** are intermingled amongst one another about a circumference of sweeper **400**. In other implementations, bristles **470** and **472** may be clustered in groups or bands. In some implementations, sweeper **400** may be removably attached, allowing it to be interchanged with other sweepers having different characteristics to accommodate different snow characteristics.

[0079] FIG. **16** illustrates sweeper **480**, another implementation of sweeper **400**. Sweeper **480** is similar to sweeper **407** except that sweeper **480** includes a plurality of resilient flexible and bendable paddles **482** circumferentially arranged about rotational axis **408** of sweeper **480**. In yet other implementations, sweeper **400** may have other configurations.

[0080] Cutting system **40** comprises a system or mechanism to direct a fluid (gas and/or liquid) at packed snow (or ice). In the example illustrated, as shown by FIGS. **11** and **17**, cutting system **40** comprises compressed gas source **500**, tube or conduit **502**, additive source **504**, heater **506** and compressed gas knife **508**. Compressed gas source **500** comprises source of compressed gas, such as compressed air. In other implementations, the compressed gas may comprise other types of gases. In one implementation, compressed gas source **500** comprises a compressor. In one implementation, compressed gas source **500** comprises a belt driven compressor, wherein a belt **511** is operably between pulley **512** connected to the vertical output shaft **60** and pulley **514** connected to an input shaft of the belt driven compressor **500** (as seen in FIG. **2**). In other implementations, the powering of the compressor serving as source **580** connected to vertical output shaft **60** by a chain and sprocket assembly or a gear train. In other implementations, compressed gas source **500** may comprise a compressor that is electrically powered. In other implementations compressed gas source **500** may comprise one or more tanks of precompressed gas which are selectively discharged to knife **508**.

[0081] Conduit **502** extends from compressed gas source **500** to compressed gas knife **508**. Conduit **502** comprises a plenum, manifold or tube. In implementations where compressed gas source **500** extends adjacent to knife **508**, conduit **502** may be omitted.

[0082] Additive source **504** (schematically shown) comprises a mechanism configured to supply one or more additives to the stream of compressed gas supplied by source **500**. In one implementation, additive source **500** comprises a reservoir of one or more additives which are drawn into the stream of compressed gas flowing through conduit **502**, such as along a venturi in conduit **502**. In another implementation, additive source **504** includes a pump for actively pumping one or more additives, added a selectively adjustable rate, into the stream of compressed gas from source **500**.

[0083] In one implementation, additive source **504** adds alcohol to the stream of compressed gas to facilitate melting of the compacted snow or ice. In another implementation, additive source **504** adds other melting ingredient such as a calcium chloride slurry, a liquid deicer or a liquid snow melter. In yet other implementations, additive source **504** may add one or more other additives or may be omitted.

[0084] Heater **506** comprises a device or mechanism to apply heat to the stream of compressed gas and/or additives flowing through conduit **502**. In other implementations, heater **506** may heat the gas or additives prior to such gas are additives entering conduit **502**. By applying heat to the gas and/or additives, heater **506** further enhances the ability of air knife **508** to cut through or breakup compacted snow and ice. In one implementation, heater **506** comprises one or more thermally conductive structures that thermally conduct heat from one or more portions of engine **26** to locations adjacent to conduit **502** to heat an interior of conduit **502**. In another implementation, heater **506** comprises a conduit which channels air heated by engine **26** to conduit **502** to heat an interior of conduit **502** or to heat portions of source **500** or source **504**. In one implementation, conduit **502** itself may extend adjacent to portions of engine **26** to receive heat from engine **26**. In such implementations, at least portions of conduit **502** such as those portions extending adjacent to the heat transfer mechanisms of heater **506** may be formed from highly thermally conductive material such as aluminum or copper. As a result, heat generated by engine **26** that would otherwise be discharge may be recycled to assist in breaking up cutting through compacted snow.

[0085] In other implementations, heater **506** may comprise one or more electrically resistive heat generating coils encircling or extending adjacent to portions of conduit **502** or portions of sources **500**, **504**, wherein electric current is circulated across the coils to heat the gas and/or additives. In another implementation, heater **506** may alternatively or additionally heat the compressed gas source knife **508**, wherein the heated portions of knife **508** may heat the gas or additives passing their through or wherein knife **508** itself may be brought into contact with compacted snow. In other implementations, heater **506** may be omitted.

[0086] Compressed air knife **508** comprises a mechanism configured and supported so as to direct the compressed gas and/or additives at the terrain **52** underlying snow thrower **20**. In one implementation, knife **508** directs the compressed gas and/or additives at a forward angle, forward of lower edge of a mouth of auger housing **130**. As shown by FIG. **11**, in one implementation, knife **508** extends along a majority of an axial length of main auger **300**. In one implementation, knife **508** comprises a manifold having a plurality of outlets, nozzles or orifices **512** dispose along edge **514** of scraper bar **516** located along a lower edge of a mouth of auger housing **130**. In one implementation, the compressed gas and/or additives is directed toward at least one area ahead of main auger **300** and another area behind main auger **300**. In one implementation, the compressed gas and/or additives are directed forward a rotational axis of main auger **300** also being directed rearward of the rotational axis of main auger **300**.

[0087] In one implementation, knife **508** directs the gas/additives forwardly of the edge **514** of scraper bar **516**. In one implementation, the orifices **512** extend at different angles towards the underlying terrain **52**. Because the gas and/or additives are directed at different angles at different locations in the pack snow, the gas and/or additive may more effectively breakup the pack snow.

[0088] In the example illustrated, the compressed gas or compressed air is provided a pressure and rate to remove snow that is not removable by auger **300**, such as compacted or compressed snow. In one implementation, the compressed gas is pulsed. In one implementation, the pulses of the compressed gas are user adjustable between a plurality of non-zero pulsed settings.

[0089] In one implementation, characteristics of the compressed gas and/or additives (the selection of additives or the rate at which additives are added) may be varied in response to signals received from one or more sensors **520** which detect one or more characteristics of the snow. For example, in one implementation, optical sensors may be utilized to detect a degree to which the snow is compacted. Based on signals from such optical sensors, controller may turn on or turned off the supply of compressed gas and/or the addition of additives. In one implementation, the controller may adjust characteristics of the compressed gas and/or characteristics of the additive being supplied through manifold knife **508**. In one implementation, the angle at which compressed air and/or additives is directed toward the snow or the specific nozzles or orifices from which the compressed gas and/or additives may be controlled or adjusted based upon such signals. For example, compressed gas at different pressures may be ejected from different orifices.

[0090] In one implementation, the pulse at which compressed gas is supplied by source **500** or released by knife **508** may be adjusted based upon signals from sensor **520**. In one implementation, the signal from sensor **520** may additionally or alternatively be utilized to control the heating provided by heater **506**. In one implementation, sensors **520** may additionally or alternatively include a temperature sensor, wherein adjustments are made by controller in response to the sensed temperature. For example, heat being supplied by heater **506** may be increased in response to the sensing of extremely cold temperatures falling below a predefined threshold. In one implementation, each of the aforementioned characteristics such as the heat being supplied by heater **506**, the existence or mixture of additives being supplied by additives source **504** and the characteristics of the compressed gas being supplied by source **500** or being released by knife **508** may be adjusted by one or more actuators actuated in response to control signals from a controller based upon one or more sensors or based upon manual inputs or control adjustments made by the user.

[0091] Impeller **42** comprises a rotatable snow moving member within impeller housing **34** that is configured to receive snow from auger system **36** burn opening within auger housing **130** and is further configured to throw or impel such snow through an opening in impeller housing **34** and through chute assembly **44**. As noted above, in one implementation, impeller **42** has an outer diameter larger than the outer diameter of main auger **300**, wherein the smaller outer diameter of main auger **300** allows auger housing **130** to be shallower such that are housing **130** may be formed from a single layer or sheet of material that is deformed, bent or deep drawn and wherein the larger diameter of impeller **42** maintains the throw distance for snow thrower **20**.

[0092] Chute assembly **44** directs the snow impelled by impeller **42** away from snow thrower **20** in one or more directions. Chute assembly **44** comprises lower or main chute **600**, main chute rotating system **602**, deflector **604** and deflector deflection system **606**. Main chute **600** comprises a tubular structure extending upward from an opening within impeller housing **34**.

[0093] Main chute rotating system **602** comprise a mechanism configured to rotate main chute **600** about a vertical or a substantially vertical axis. In the example illustrated, main chute rotating system **602** utilizes one or more powered (rotational torque not being directly manually generated) sources. FIGS. **18** and **19** illustrate one particular example implementation of main chute rotating system **602**. As shown by FIG. **18**, system **602** comprises annular ring gear **610**, pinion gear **612**, actuator **614** and manual control **616**.

[0094] Annular ring gear **610** is affixed to main chute **600** so as to rotate with main chute **600**. Gear **610** has downwardly facing teeth enmeshed engagement with pinion gear **612**. Pinion gear **612** is operably coupled to actuator **602** for being rotated by actuator **602**. In the example illustrated, actuator **602** comprises an electrically powered motor (powered off of a battery). In the example illustrated, actuator **602** comprises a precisely controllable motor, such as a step motor or servomotor. Actuator **602** is connected to manual control **616** in a wired or wireless fashion (as schematically shown). Manual control **616** comprises a device configured to control actuator **602** in response to manual inputs from a person. In the example illustrated, manual control **616** comprises a three position toggle switch, wherein the depressment of one side of the switch results in rotation of main chute **600** in a first direction, wherein the depressment of the other side of the switch results in rotation of main chute **600** in a second opposite direction and wherein the switch in the neutral default position maintains chute **600** in a stationary position. In other implementations, other rotary actuators and other manual controls may be utilized. In still other implementations, actuator **614** and manual control **616** may be omitted, wherein rotational torque for rotating pinion gear **612** and chute **600** may alternatively be generated manually through the use of a manual crank.

[0095] Deflector **604** receives snow from main chute **600** and directs or deflects the snow at one of a plurality of selected angles with respect to horizontal. The selected angle impacts the height of the snow being thrown and the location at which the thrown snow lands. FIG. **20** illustrates deflector **604** in more detail. As shown by FIG. **20**, deflector **604** is configured to telescope with respect to main chute **600**.

[0096] In the example illustrated, deflector **604** comprises a tubular chute member having a top wall **620** and a pair of sidewalls **622**. In the example illustrated, deflector **604** is open opposite to top wall **620**. In the example illustrated, lower main chute **600** has one of projections and detents well the upper chute or deflector **604** has the other of projections and detents, wherein at least one of the chute **600** and deflector **604** resiliently flex to permit projections to be snapped into the detents and wherein the projections and the detents cooperate to permit pivoting of deflector **604** relative to chute **600**. In the example illustrated, main chute **600** includes an elongate slot **630** while deflector **622** has an elongate slot **632**. Main chute **600** has a projection **636** received within slot **632** while deflector **604** has a projection **638** received within slot **630**. Slots **630**, **632** and projection **636**, **638** form a four-bar linkage facilitating pivoting and telescoping of deflector **604** with respect to main chute **600**. As a result, deflector **604** may be positioned outside of a normal arc. Deflector **604** and chute **600** may additionally be attached through a simple manual snapping into place.

[0097] FIG. **20** illustrates the repositioning of deflector **604** as a result of pivoting of deflector **604** such that projection **636** moves from position **1** to position **2** within slot **632** and such that projection **638** moves from position **1** to position **2** in slot **630**. In other implementations, the shape of slots **630**, **632** and their relative positions may be adjusted to provide different available paths or arcs for deflector **604**. In other implementations, in lieu of slots and pins, deflector **604** and main chute **600** may utilize other projections and detents, such as tongue grooves and the like.

[0098] As shown by FIG. **18**, deflector deflection system **606** comprise a mechanism to selectively reposition deflector **604** with respect to chute **600** and to retain deflector **604** in a selected one of a plurality of available positions. In the example illustrated, system **606** comprises actuator **650** and manual control **652**. Actuator **650** comprises a powered device (torque or force to reposition deflector **604** not being manually provided) to move deflector **604**. In the example illustrated, actuator **650** comprises a linear actuator having one end attached to main chute **600** and a second end pivotally connected to deflector **604**. In the implementation shown, actuator **650** comprises an electric solenoid (powered by a battery) mounted chute **600** and pivotally attached to deflector **604**. In other implementations, actuator **650** may comprise a linear actuator such as a hydraulic or pneumatic cylinder-piston assembly having one portion fixed to chute **600** and a second portion (the piston) pivotally coupled to deflector **604**. Actuator **650** is in communication with and connected to manual control **652** in a wired or wireless fashion (as schematically shown).

[0099] Manual control **652** comprises a device configured to control actuator **650** in response to manual inputs from a person. In the example illustrated, manual control **652** comprises a three position toggle switch, wherein the depressment of one side of the switch results in pivoting of deflector **604** in a first direction, wherein the depressment of the other side of the switch results in pivoting of deflector **604** in a second opposite direction and wherein the switch in the neutral default position maintains deflector **604** in a stationary position. In other implementations, other actuators (rotary and linear) and other manual controls may be utilized. In still other implementations, actuator **650** and manual control **652** may be omitted, wherein repositioning of deflector **604** may alternatively be performed through the direct application of manual force to deflector **604** and wherein the selected position may be secured through use of a manually actuated set screw and the like.

[0100] Lighting system **46** supplies and directs light to regions proximate to snow thrower **20**. As shown by FIGS. **11** and **21**, lighting system **46** comprises chute mounted lights **700** and auger housing mounted lights **702**. Chute mounted lights **700** comprise one or more sources of light (powered by a battery or other energy source) mounted to or coupled to lower main chute **600** configured to emit light in a forward direction with respect to chute **600** as indicated by arrows **706**. In the example illustrated in FIG. **21**, lights **700** include a top-flight focus up and to one side, a center light focused straight ahead and a bottom light focused down and out to the other side, wherein a wide zone is illuminated. In other implementations, the focusing of such lights may be different. Because lights **700** are mounted to main chute **600** which is selectively rotatable (as described above), the area being lit by lights **700** may be also selected in response to a person rotating chute **600**. In other words, lights **700** may be aimed by the user using the same mechanism that rotates main chute **600**.

[0101] Housing mounted lights **702** comprise one or more sources of light (powered by a battery or other energy source) mounted to auger housing **130** or otherwise provided above and adjacent to the mouth of auger housing **130**. In the example illustrated, lights **702** or carried by a rim **710** of auger housing **130**. Lights **702** aim or focus light in a forward direction in front of auger housing **130**. Because lights **702** are mounted along the rim of auger housing **130**, lights **702** are closest to the front of snow thrower **20**, being able to better illuminate regions in front of snow thrower **20**.

[0102] Lights **702** cooperate with lights **700** to provide a composite lit region which includes both regions in front snow thrower **20** as well as regions to either side of snow thrower **20**. In particular, lights **702** illuminate areas in front of snow thrower **20** while light **700**, upon the rotation of chute **600**, illuminate areas to a side of snow thrower **20**. As a result, the person using snow thrower **20** cannot only better see where he or she is pushing or driving snow thrower **20**, but also where the snow is being thrown by snow thrower **20**. In other implementations, other light sources may be employed. In other implementations, one or both of light sources **700**, **702** may be omitted.

[0103] FIGS. **22-25** illustrate snow thrower **724**, another example implementation of a snow thrower **20** including another example implementation of lighting system **46**. Snow thrower **724** is similar to snow thrower **20** except that snow thrower **724** includes alternative locations for light sources **702**. In the example shown in FIGS. **22-25**, a top panel or top wall of water housing **130** has a downwardly bent rim **720** upon a front surface of which are mounted light sources **702**. Power supply to such light sources through or along a backside of auger housing **130** behind rim **720**. In other implementations, a top surface of our housing **130** may be provided with one or more solar panels which may be used to collect solar energy which is stored in a battery in later use by light sources **702** for powering light sources **702** when needed.

[0104] Handle arrangement **48** comprises a handle mechanism by which a person may push and/or steer snow thrower **20** as well as control operation of snow thrower **20**. Handle arrangement **48** (shown in FIG. **1**) accommodates persons of different height and preferences. As shown by FIG. **26**, handle arrangement **48** comprises arms **800**, dashboard **802** and manual inputs **804**.

[0105] Arms **800** comprise bars, rods or other elongated structures having a first end portion **808** pivotally connected or coupled to frame **22** (shown in FIG. **1**) for pivotal movement about a horizontal axis **810** and a second end portion **812** pivotally connected to dashboard **802** for pivotal movement about a horizontal axis **814**.

[0106] Dashboard **802** comprises one or more structures extending generally above arms **800** and pivotally connected arms **800** about axis **814**. Dashboard **802** carries or supports one or more manual controls **804**. As shown by FIG. **26** which illustrates two alternative positions for handle arrangement **48**, arms **800** may pivot about axis **810** in a first direction while dashboard **802** pivots about axis **814** in a second opposite direction such that the overall height of handle arrangement **48** may be reduced or increased while reducing or minimizing a change in the horizontal or angular orientation of dashboard **802** and the supported manual controls **804**. In addition, not only the height of dashboard **802** may be adjusted, but also its horizontal positioning. In such an example, handle arrangement **48** offers four repositioning points, the extreme positions or endpoints of the arcs about axes **810** and **814** at any point between which arms **800** and dashboard **802** may be selectively positioned and retained.

[0107] Manual controls **804** comprise devices by which manual inputs may be provided to snow thrower **20**. As noted above, examples of manual controls **804** include manual controls **616** and **652** utilized to control the positioning of main chute **600** and deflector **604**. Manual controls **804** further include controls to adjust the speed at which snow thrower **20** is being propelled are driven as well as to adjust the speed or torque of auger system **36** and impeller **42**. As schematically shown by FIG. **1**, in one implementation, snow thrower **20** includes a controller **820** operably coupled to one or more actuators (solenoids and the like), wherein the controller generates control signals causing the actuators to selectively adjust output of engine **26** and/or the transmission of snow thrower **20**.

[0108] For purposes of this application, the term "processing unit" shall mean a presently developed or future developed processing unit that executes sequences of instructions contained in a memory. Execution of the sequences of instructions causes the processing unit to perform steps such as generating control signals. The instructions may be loaded in a random access memory (RAM) for execution by the processing unit from a read only memory (ROM), a mass storage device, or some other persistent storage. In other embodiments, hard wired circuitry may be used in place of or in combination with software instructions to implement the functions described. For example, controller **820** may be embodied as part of one or more application-specific integrated circuits (ASICs). Unless otherwise specifically noted, the controller is not limited to any specific combination of hardware circuitry and software, nor to any particular source for the instructions executed by the processing unit.

[0109] Controller **820** generates such control signals (for adjusting output of the engine **26** or its associated transmission to adjust a speed at which snow thrower **20** is driven or propelled and/or to adjust a speed or torque of auger system **36** or impeller **42**) in response to input to manual inputs or controls **804** which results in electrical control signals being transmitted through an electrical transmitting line **824** (schematically shown) to controller **820**. For example, one or more of manual controls **804** may include one or more electrical switches which caused the generation of electrical control signals which are transmitted or otherwise communicated to controller **820**. Because snow thrower **20** utilizes electronics and electrical signals generated at dashboard **802** to control the operation of snow thrower **20**, rather than push pull cables and other force-type transmission mechanisms that rely upon the transmission of force from the handle to control the operation of snow thrower **20**, handle arrangement **48** may be moved through such multiple pivot points and arcs for user customization without impacting the transmission of control inputs. In particular, with push pull cables and other force type control transmissions, repositioning of the handle may impact the length or path of the push pull cable which may impact the receipt of control inputs. Because snow thrower **20** utilizes electrical signals, such variations are omitted; the control system of snow thrower **20** offers greater consistency and reliability.

[0110] In other implementations, electrical transmitting line **824** may be omitted, where such control signals are communicated wirelessly in response to inputs provided by manual controls **804** on dashboard **802**. In other implementations, push pull cables may be utilized to transmit control adjusting actions entered by manual controls **84** to controller **820** or directly to the actuators associate with engine **26** or the transmission.

[0111] FIG. **27** illustrates snow thrower **20** with handle arrangement **848**, an alternative implementation handle arrangement **48**. Handle arrangement **848** is similar to handle arrangement **48** except that handle arrangement **848** additionally includes lower arms **852** (two alternative positions of the pair of arms **852** being shown). Each of the lower arms **852** includes a lower portion right **56** housing **22** for pivotal movement about a horizontal axis **858** and a second portion **860** pivotally connected to one of arms **800** for pivotal movement about a horizontal axis **862**. Each lower arm **852** further includes an elongate slot **864** receiving a projection or pin **866** projecting from the associated arm **800**. Slot **864** slide receives pin **866** to limit an extent to which arm **852** may pivot about axis **862** with respect to arm **852**. Each of arms **800**, **852** and dashboard **802** are selectively retained in one of a plurality of positions by one or more retainers or retaining mechanisms, such as pins and detents (not shown).

[0112] As shown by FIG. **27** which illustrates two alternative positions for handle arrangement **848**, arms **852** may pivot about axes **858**, arms **800** may pivot about axis **866** in a first direction while dashboard **802** pivots about axis **814** in a second opposite direction such that the overall height of handle arrangement **48** may be reduced or increased while reducing or minimizing a change in the horizontal orientation of dashboard **802** and the supported manual controls **804**. In addition, not only the height of dashboard **802** may be adjusted, but also its horizontal positioning. In such an example, handle arrangement **48** offers six repositioning points, the extreme positions or endpoints of the arcs about axes **858**, **862** and **814** at any point between which arms **858**, **800** and dashboard **802** may be selectively positioned and retained. In such an implementation, dashboard **802** may be vertically moved without any horizontal movement of dashboard **802**.

[0113] Control system **50** facilitates user control of the operation of snow thrower **20**. FIG. **28** schematically illustrates control system **50**. As shown by FIG. **28**, control system **50** comprises battery **900**, female charging port **902**, retractable charging plug **904**, variator **906**, variator **908**, manual inputs or manual controls **804** (also forming part of handle arrangement **48**), speed display **912** and throw display **916**. Although not illustrated, in other implementations, control system **50** may include additional display elements and additional manual controls. Battery **900** comprises a rechargeable battery supported by frame **22** for storing and supplying power to snow thrower **20**.

[0114] Female charging port **902** comprise a female electrical port for being connected to a male plug of electrical cord to allow battery **900** to be connected to an electrical outlet for charging battery **900** or for directly supplying power to snow thrower **20** during starting of engine **26**. In the example illustrated, female charging port **902** is housed or supported in dash panel or dashboard **802**. In other implementations, port **902** may have other locations on snow thrower **20**.

[0115] Retractable charging plug **904** comprise a male electrical plug at the end of a retractable coil. Plug **904** is configured to be pulled from snow thrower **20** and connected to inlet outlet for charging battery **900** or for supplying and directing power during starting of engine **26**. In the example illustrated, plug **904** and its retractable coil are provided on dash panel or dashboard **802**. In other implementations, plug **904** may extend from other portions of snow thrower **20**.

[0116] Variator **906** comprise a mechanical variator operably coupled between engine **26** and auger system **36** an impeller **42** as part of the transmission of snow thrower **20**. For purposes of this disclosure, the term "coupled" shall mean the joining of two members directly or indirectly to one another. Such joining may be stationary in nature or movable in nature. Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate member being attached to one another. Such joining may be permanent in nature or alternatively may be removable or releasable in nature. The term "operably coupled" shall mean that two members are directly or indirectly joined such that motion may be transmitted from one member to the other member directly or via intermediate members. The term "fluidly coupled" shall mean that two are more fluid transmitting volumes are connected directly to one another or are connected to one another by intermediate volumes or spaces such that fluid may flow from one volume into the other volume.

[0117] Variator **906** is configured to vary or split power being delivered to auger system **36** and impeller **42** such that auger system **36** may be driven at a different speed and/torque as compared to impeller **42**. In one implementation, variator **906** comprises a frictional mechanical variator. In other implementations, other forms of a variator may be employed.

[0118] Variator **908** comprise a mechanical variator operably coupled between engine **26** and traction members **24** as part of the transmission of snow thrower **20**. Variator **908** is configured to vary or split power being delivered to traction members **24** as compared to the power being delivered to auger system **36** and impeller **42** such that traction members **24** may be driven at a speed different than the speed at which impeller **42** is driven or the speed at which auger system **36** is driven. In one implementation, variator **906** comprises a frictional mechanical variator. In other implementations, other forms of a variator may be employed. In other implementations, one or both of variator **906**, **908** may be omitted.

[0119] Manual controls **804** comprise inputs by which a person control snow thrower **20**. Manual controls **804**, provided on dashboard **802**, comprise controls **616** and **652**, starter control **920**, traction drive control **922**, auger control **924** impeller or throw control **926**. Controls **616** and **652** control the positioning of main chute **600** and deflector **604**, respectively, and are described above.

[0120] Starter control **920** comprises a turnkey, the position of which is sensed, such as with a potentiometer, to generate electrical signals which are transmitted to controller **820** to initiate starting of engine **26** and the continued operation of engine **26**. Traction drive control **922** comprises a pivotable lever, the position of which is sensed, such as with a potentiometer, to generate electrical signals which are transmitted to controller **820** to control an on-off state and the speed at which traction members **24** are driven to move snow thrower **20**. Auger control **924** comprises a slide bar or pivotable lever, the positioning of which is sensed, such as with a potentiometer, to generate electrical signals which are transmitted to controller **820** to control a speed of auger system **36**. Throw control **926** comprises a pivotable lever, the position of which is sensed, such as with a potentiometer, to generate electrical signals which are transmitted to controller **822** control a speed of impeller **42**. Each of such controls are merely exemplary in nature. In other implementations, each manual control **804** may have a different configuration.

[0121] Speed display **912** comprises a visible display indicating on dashboard **802** the speed at which traction members **24** are being driven. Throw display **916** comprises a visible display indicating on dashboard **802** the speed at which impeller **42** is being driven. In the example illustrated, speed display **912** and throw display **916** comprises triangular displays wherein a region is filled in or underline is presented to indicate the present state with respect to the minimum and maximum velocities. In one implementation, the line or region may comprise a dial or member which moves in response to control signals provided by controller normally **20**. In another implementation, line or region may be provided by light emitting diodes and the like. In other implementations, displays **912** and **916** may have other configurations. For example, displays **912** and **916** may alternatively comprise dials, alphanumeric displays and the like. Displays **912** and **916** provide a person with a visual indication of the speed at which the snow thrower's being driven as well the speed at which impeller **42** is being driven (corresponding to the distance at which snow may be being thrown). In other implementations, one or both of displays **912**, **916** may be omitted or additional displays may be provided.

[0122] Controller **820** comprises one or more processing units configured to generate control signals directing operation of engine **26**, variator **906**, **908** and displays **912**, **916**. Controller **820** generates such control signals in response to electrical signals received from manual controls **804** as well from one or more sensors associated with snow thrower **20**. As noted above, in some implementations, controller **820**

may additionally generate control signals controlling the operation of cutting system **40**.

[0123] In operation, battery **900** is charged through port **902** or plug **904**. Power from battery **900** may be utilized to power lighting system **46**, cutting system **40** as well as control system **50**. In some implementations, power from battery **900** may be utilized in place of engine **26** for powering one or more of auger system **36**, sweeper system **38**, impeller **42** or traction members **24**. In one implementation, snow thrower **20** may include an onboard generator for charging battery **900** or for powering some of the aforementioned components.

[0124] In response to input received by manual controller relying **20**, electrical signals are transmitted to controller **820**. In response to such signals, controller **820** generates control signals to one or more actuators **930** which set a choke associated with engine **26**, prime engine **26** and turnover engine **26** to start engine **26**. Such actuators **930** may comprise electric solenoids, like the switches and the like. As a result, start up of snow thrower **20** is accomplished in a single step, actuation of controller **920**. In other implementations, such startup steps may be individually carried out in response to actuation of multiple separate manual controls.

[0125] During operation of the snow thrower **20**, controller **820** generate control signals based upon input via manual control **804** to adjust the speed are operation of traction members **24**, auger system **36** and impeller **42**. In one implementation, controller **820** transmits signals to display **912** and display **916** causing such displays to visibly present information regarding the current speed of traction members **24** and the current velocity of impeller **42**, respectively. In one implementation, controller **828** generates such control signals based upon the actual control signals transmitted by controller **820** to engine **26**, or variators **906**, **908** which correspond to such speed. In another implementation, controller **820** may generate such signals for displays **912** and **916** based upon one or more sensors sensing the actual speed of traction members **24** and impeller **42**.

[0126] FIGS. **29-31** illustrate an example of the hybrid snow thrower or snow blower **920**. Snow thrower **920** comprises a hybrid between a single stage snow thrower and a two stage snow thrower. Snow thrower **920** comprises torque source **926**, transmission **928**, auger housing **930**, chute **944**, snow impelling blades **950**, snow channeling or moving blades **952**A, **952**B (collectively referred to as blades **952**) and speed changing devices **960**A, **960**B (collectively referred to as speed changing devices **960**). Torque source **926** comprises a source of torque for rotationally driving blades **950** and **952**. In one implementation, torque source **926** comprises an internal combustion engine. Another implementation, torque source **926** comprises a battery or electrically powered motor. Although torque source **926** has a single output which is used to drive both blades **950**, **952**, in other implementations, torque source **926** may include two separate outputs with one output for blades **950** and another output for blades **952**. In yet other implementations, snow thrower **920** may include separate torque sources for blades **950** and blades **952**.

[0127] Transmission **928** transmits torque from torque source **926** to blades **950**, **952** to rotationally drive blades **950**, **952** within auger housing **930**. In one implementation, transmission **928** may comprise a series of gears. In another implementation, transmission **928** may comprise a chain and sprocket arrangement or a belt and pulley arrangement. In some implementations, transmission **928** may comprise a combination of such torque transmitting mechanisms. In the example illustrated, transmission **928** extends along a side or exterior of auger housing **930**, wherein transmission **928** is connected to one drive shaft of one of blades **952** such that torque is transmitted first to one of blades **952** prior to being transmitted to plate **950**. In other implementations, transmission **928** may centrally extend in a forward direction from torque source **926** to blades **950** so as to first transmit torque to blades **950** prior to transmitting torque to blades **952**.

[0128] Auger housing **930** houses snow engaging blades **950**, **952**. Auger housing **130** directs snow to blades **950**, **952**. In one implementation, auger housing **930** comprises a single integral structure integrally formed as a single unitary body of a single sheet or layer of material that is deformed or deep drawn. In other implementations, auger housing **930** may be formed from multiple structures which are welded, fastened or otherwise joined to one another. In other implementations, auger housing **930** may include other features described above such as extensions **132**.

[0129] Chute **944** comprises a tubular or semi-tubular structure extending from an opening **964** within auger housing **930**. Chute **944** extends upward and outward to direct impel snow forwarder to a side of snow thrower **920**. In one implementation, chute **944** may be similar to chute **44** described above.

[0130] Snow impelling blades **950** comprise blades, paddles or other structures configured to be rotationally driven about a rotational axis **966** (shown in FIG. **31**) to drive snow upward through opening **964** and through chute **944** for discharge. In the example illustrated, snow impelling blades **950** comprise panels or paddles **968** radially extending outward from axis **966** and radially outward from drive shaft **970** with each panel **968** extending in a plane intersecting and parallel to axis **966**. As a result, snow engaged by blade **968** is impelled upward and outward. In the example illustrated, blade **968** further includes outer portions configured to engage or come to close proximity with a ground so as to pick up snow. In one implementation, blades **968** include an outer elastomeric or flexible rubber-like outer extremity portion for engaging the ground. In other implementations, blades **968** may have other configurations.

[0131] Snow moving or snow engaging blades **952** (schematically shown) comprise blades rotatably supported within auger housing **930** and configured to engage the ground, to mulch snow and drive snow towards snow engaging blades **950**. In the example illustrated, blades **952** comprise helical blades or helical augers for being rotatably driven about axis **966**. In the example illustrated, blades **952**A drive snow in a direction indicated by arrow **974** parallel to and along axis **966** towards blades **950**. Blades **952**B drive snow in a direction indicated by arrow **976** parallel to and along axis **968** towards blades **950**. In the example illustrated, blades **952** are driven at a speed slower than a speed at which plates **950** are rotationally driven. Although blades **950**, **952** are illustrated as being rotatable about a single axis **966**, in other implementations, blades **950**, **952** may be driven about distinct or different axes with respect to one another.

[0132] Speed changing devices **960** comprise devices configured to change or adjust a speed between an input torque and an output torque. Speech any device **960** are sometimes also referred to as speed adjusters, speed reducers and the like. Speed changing device **960** facilitates rotation of blades **952** at a lower speed as compared to the rotation of blades **950**. As a result, snow thrower **920** utilizes less power, allowing a smaller torque source **926** utilized. Said another way, speed changing device **960** facilitate rotation of those blades utilized to throw snow at a greater speed than the rotation of those blades which merely move snow in a substantially horizontal direction. Speed is provided where it is utilized most effectively, while low speed higher torque provided where it is utilized most effectively.

[0133] In one implementation, each of speed changing devices **960** comprises a planetary gear arrangement. In other implementations, each of speed changing devices **960** may have other configurations. In implementations where separate transmissions independently drive blades **950** with respect to blades **952**, speed changes **960** may be omitted.

[0134] In operation, snow engaging blades **950** are rotationally driven within auger housing **930** opposite to chute **944** at a first be while snow engaging blades **952** are rotationally driven within auger housing **930** at a second speed less than the first beat. In the example illustrated, blades **952** are driven about a single rotational axis. Blades **952** move snow towards blades **950**. Blades **950** extend parallel to rotational axis **966** while blades **952** helically extend at least partially about their rotational axis (and about axis **966** in the example illustrated).

[0135] Although the claims of the present disclosure are generally directed to a three stage snow thrower, the present disclosure is additionally directed to the features set forth in the following definitions.

What is claimed is:

1. A snow thrower comprising:

an auger housing;

a center snow impelling blade housed within the auger housing and comprising a rotating element;

a first blade positioned on a first side of the center snow impelling blade and configured to be driven about a rotational axis of a drive shaft; and

a second blade positioned on a second side of the center snow impelling blade and configured to be driven about the rotational axis of the drive shaft, the first blade and the second blade housed within the auger housing and configured to drive snow to the center snow impelling blade;

wherein the auger housing directs snow to the center snow impelling blade, the first blade, and the second blade.

2. The snow thrower of claim **1**, wherein the rotating element comprises one or more paddles radially extending outward from the rotational axis of the drive shaft.

3. The snow thrower of claim **2**, wherein an outermost edge of the one or more paddles is offset from the rotational axis.

4. The snow thrower of claim **2**, wherein the one or more paddles comprises a portion that is substantially parallel with the rotational axis.

5. The snow thrower of claim **2**, wherein each of the one or more paddles extend in a plane intersecting the rotational axis.

6. The snow thrower of claim **2**, wherein each of the one or more paddles extend parallel to the rotational axis.

7. The snow thrower of claim **2**, wherein each of the one or more paddles comprise an outer portion for engaging with a ground.

8. The snow thrower of claim **1**, wherein the first blade comprises a first helical portion and the second blade comprises a second helical portion.

9. The snow thrower of claim **1**, wherein the first blade and the second blade helically extend at least partially about the rotational axis.

10. The snow thrower of claim **1**, wherein the first blade, the second blade, and the center snow impelling blade are driven by a torque source, the torque source comprising an internal combustion engine.

11. The snow thrower of claim **1**, wherein the first blade, the second blade, and the center snow impelling blade are driven by a torque source, the torque source comprising an electrically powered motor.

12. The snow thrower of claim **1**, further comprising a transmission configured to transmit torque from a torque source to the first blade, the second blade, and the center snow impelling blade.

13. The snow thrower of claim **12**, wherein the transmission extends along an exterior of the auger housing and is coupled to the drive shaft.

14. A snow thrower comprising:

an auger housing; and

an auger assembly housed within the auger housing and comprising:

a center snow impelling blade rotating about a rotational axis of a drive shaft and comprising one or more paddles extending radially outward from the rotational axis;

a first helical blade positioned on a first side of the center snow impelling blade; and

a second helical blade positioned on a second side of the center snow impelling blade, the first helical blade and the second helical blade configured to be driven about a rotational axis of the drive shaft to drive snow to the center snow impelling blade;

wherein at least one portion of the one or more paddles is offset from the rotational axis.

15. The snow thrower of claim **14**, wherein an outermost edge of the one or more paddles is offset from the rotational axis.

16. The snow thrower of claim **15**, wherein the outermost edge is substantially parallel with the rotational axis.

17. The snow thrower of claim **14**, wherein each of the one or more paddles extend in a plane intersecting the rotational axis.

18. The snow thrower of claim **14**, wherein each of the one or more paddles extend parallel to the rotational axis.

19. The snow thrower of claim **14**, wherein each of the one or more paddles comprise an outer portion for engaging with a ground.

20. The snow thrower of claim **14**, wherein the first blade and the second blade helically extend at least partially about the rotational axis.

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