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(72) Inventeur/Inventor:
SENCHUK, CRAIG, CA

(73) Propriétaire/Owner:
ATOM JET INDUSTRIES (2002) LTD., CA

(74) Agent: ADE & COMPANY INC.

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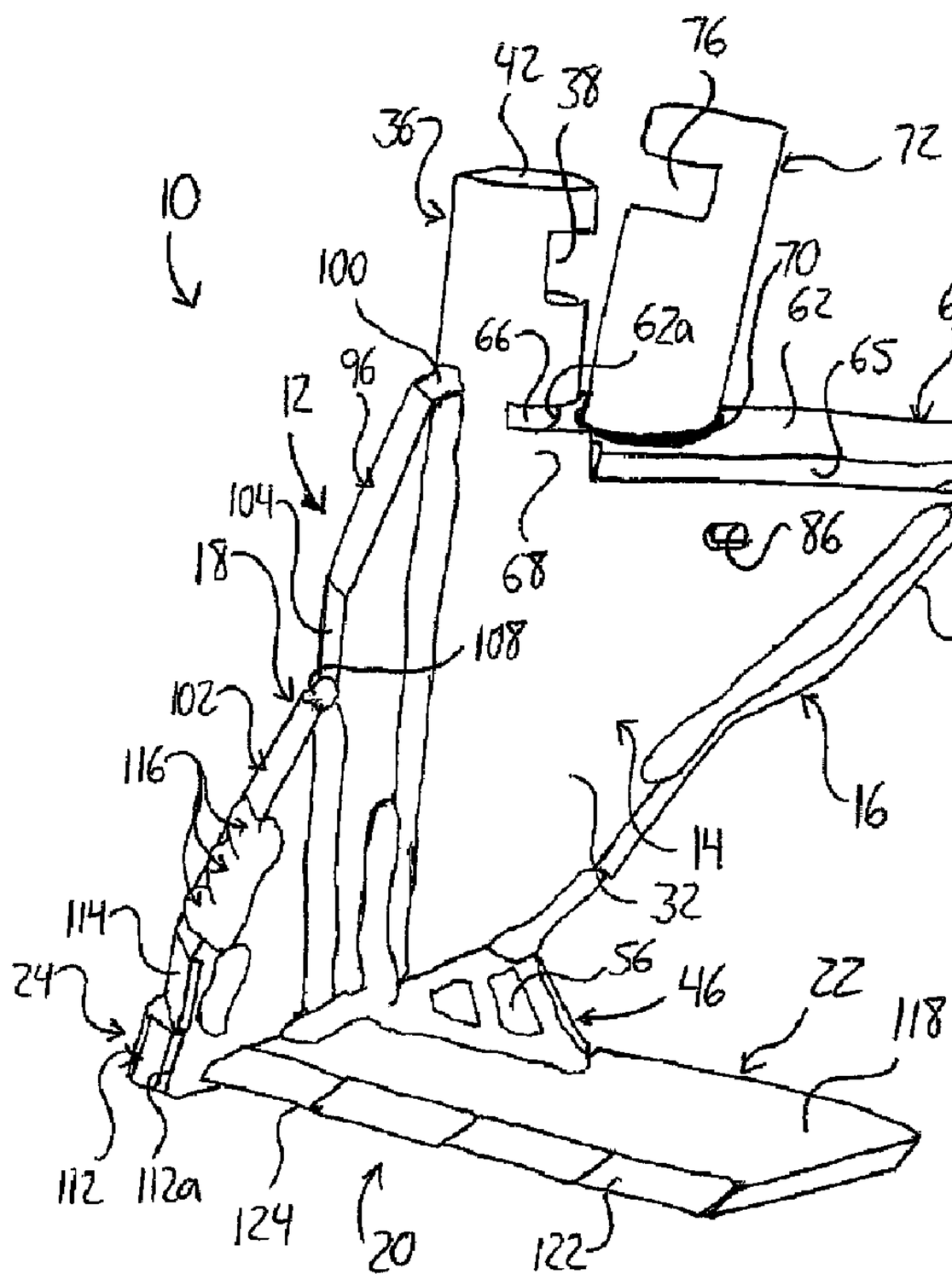

(57) Abrégé/Abstract:
A sweep opener for pulling on an agricultural implement in a forward working direction features a central body and a sweep comprising a pair of wings proximate a bottom end of the central body and projecting laterally outward therefrom and rearward

CA 2627095 C 2014/09/09

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(57) Abrégé(suite)/Abstract(continued):
away from the front end. A delivery channel extends downward to an outlet proximate the bottom end of the central body and ahead of a connection element defined on the central body for coupling with a shank of the agricultural implement. Seed delivered through the channel is thus released in front of the shank to avoid seed delivery interference by soil falling back into the furrow behind the shank. Inserts fixed to front edges of the wings reduce wear and tear to the wings themselves to improve the lifespan of the sweep.

ABSTRACT

A sweep opener for pulling on an agricultural implement in a forward working direction features a central body and a sweep comprising a pair of wings proximate a bottom end of the central body and projecting laterally outward therefrom and rearward away from the front end. A delivery channel extends downward to an outlet proximate the bottom end of the central body and ahead of a connection element defined on the central body for coupling with a shank of the agricultural implement. Seed delivered through the channel is thus released in front of the shank to avoid seed delivery interference by soil falling back into the furrow behind the shank. Inserts fixed to front edges of the wings reduce wear and tear to the wings themselves to improve the lifespan of the sweep.

SWEEP OPENER AND SWEEP FOR AGRICULTURAL IMPLEMENTS

The present invention relates generally to agricultural implements and more particularly to sweep style tools mountable to shanks of an agricultural implement for pulling through the soil.

BACKGROUND OF THE INVENTION

Agricultural sweeps are generally mounted on downward depending shanks or tines of an agricultural implement pulled along the ground by an agricultural tractor or the like so that the sweeps are pulled through the soil to till the ground by cutting off or uprooting undesirable plants, sowing seeds breaking up the soil, etc. A typical agricultural sweep includes an earth or ground engaging body portion having an arrowhead or triangular-like shape forming a point or nose at the forward end with two symmetrical wing-like bodies sweeping rearward therefrom to define cutting edges at the leading edges of the wings on either side of the point. A stem or mounting portion typically extends upward from the body portion for connection to the shank or tine of the implement on which it is installed.

In addition to use of such sweeps in isolation to carry out purely tilling operations, it is known to use sweeps as part of an opener assembly of an air seeder or drill to carry out the tilling or weed kill function of the sweep while simultaneously delivering seed, and sometimes fertilizer, rearward of the sweep. In such arrangements, the sweep not only cuts through weeds but also helps form a firm seed shelf beneath the ground surface onto which the seed is to be delivered. In such prior art sweep-style openers, an outlet of the seed boot through which the seed is delivered into the soil trails behind the shank that carries the sweep on the

opener or drill implement. As a result, the tendency of soil displaced by pulling of the opener through the ground to fall back into the so-formed furrow as the shank passes by may have a detrimental effect on consistent placement of seed, and possibly fertilizer when being simultaneously applied, as the soil falling back onto the newly formed seed shelf may obstruct or interfere with delivery of seed to this shelf. Consistent seed delivery promotes improved and more consistent crop germination, emergence and yield.

In addition to the desire for an improved sweep-style opener, there is also a desire to provide a sweep of improved strength and durability do to the high degree of wear and tear faced by such earth engaging agricultural implements.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a sweep opener for mounting on a shank of an agricultural implement, the sweep opener comprising:

a central body having front end, rear end, top end, bottom end and opposite lateral sides and being positionable in a vertical plane to define a forward direction by a horizontal distance from the rear end to the front end and define an upward direction by a vertical distance from the bottom end to the top end;

a sweep comprising a pair of wings proximate the bottom end of the central body and projecting from the opposite lateral sides of the central body laterally outward therefrom and rearward away from the front end;

a connection element defined on the central body proximate the rear end thereof for cooperation with a corresponding connection element defined on the

shank of the agricultural implement to facilitate coupling of the central body thereto; and

a delivery channel extending downward from an inlet proximate the top end of the central body to an outlet proximate the bottom end of the central body and ahead of the connection element in the forward direction.

Preferably there is provided a second channel extending downward from a second inlet proximate the top end of the central body to a second outlet defined on the central body ahead of the connection element in the forward direction.

Preferably the outlet of one of the channels comprises a pair of openings defined outward of the opposite lateral sides of the central body to open rearward between the wings of the sweep above the bottom end of the central body and the outlet of the other channel opens centrally between and above the pair of openings of the second outlet.

There may be provided a deflector carried on the central body below the central opening to direct material discharged through said central opening laterally outward from the opposite lateral sides of the central body.

The opening in the central body may open downward and rearward in a sloped edge of the central body defined between the opposite lateral sides thereof and sloping downward in the forward working direction.

In this instance, preferably a slope of the sloped edge of the central body facilitates mounting thereof to a C-shank with an upper portion of the sloped edge adjacent the top end of the central body sitting atop and extending generally

along a lower portion of the C-shank extending upward from a bottom end thereof with the connection element defined at the upper portion of the sloped edge.

Preferably there is provided a pair of covers extending laterally outward from the opposite lateral sides of the central body to the wings of the sweep ahead of the pair of openings in the forward direction.

Preferably the connection element of the central body comprises at least one fastener hole through which the central body is connectable to the shank by a fastener.

The sweep may be rigidly fixed to the central body.

Preferably the wings of the sweep connect to the central body ahead of the delivery channel in the forward working direction.

Preferably an angle at which the front end extends from the bottom end toward the top end, measured from a horizontal plane to the front end in the forward working direction, is greater than sixty degrees and less than ninety degrees.

Preferably the inlet of the delivery channel at the top end is positioned adjacent the front end, the front end sloping non-vertically downward away from the top end in the forward vertical direction.

Preferably the central body comprises a delivery portion through which the delivery channel extends downward and a solid portion extending from the delivery portion in the forward working direction, the wings of the sweep extending laterally outward from the central body at the solid portion thereof.

Preferably the wings of the sweep project laterally from the central body proximate an intersection of the front and bottom ends thereof.

Preferably the central body comprises a cutting tip positioned proximate a position at which the front and bottom ends intersect, the cutting tip narrowing in the forward working direction and the sweep projecting laterally away from the central body proximate the cutting tip.

According to a second aspect of the invention there is provided a sweep for mounting on a shank of an agricultural implement, the sweep comprising:

a mounting portion having front and rear ends and opposite lateral sides, a horizontal distance from the rear end to the front end defining a forward working direction;

a sweep portion carried on the mounting portion and comprising a pair of wings projecting rearward and laterally outward relative to the opposite lateral sides of the mounting body; and

inserts fixed to front sides of the wings to extend therealong and define cutting edges ahead of forwardmost edges of the wings in the forward working direction.

Preferably the inserts comprise a material of greater hardness than the wings to which the inserts are fixed.

Preferably the inserts comprise tungsten carbide.

Preferably a plurality of the inserts are fixed to the front side of each wing in an end-to-end arrangement extending therealong.

Preferably the front side of each wing slopes obliquely downward and forward from a top surface of said wing, the inserts being generally flat and lying face-down on the sloped front edges of the sweep.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, which illustrate exemplary embodiments of the present invention:

Figure 1 is a side perspective view of a sweep opener for mounting on a C-shank of a seeder.

Figure 2 is a front perspective view of the sweep opener of Figure 1.

Figure 3 is a rear perspective view of the sweep opener of Figure 1.

Figure 4 is a cross sectional view of the sweep opener of Figure 3 as taken along line IV – IV thereof.

Figure 5 is a cross section view of the sweep opener of Figure 4 as taken along line V – V thereof.

Figure 6 is a close-up rear perspective view of a sweep opener similar to that of Figures 1 to 5 but equipped with a seed deflector.

DETAILED DESCRIPTION

Figures 1 to 5 show a sweep-style opener 10 arranged for installation on a C-shank of an air seeder or drill for pulling through soil to open a seed furrow in the ground, deposit seed, and possibly fertilizer, into the furrow and simultaneously till or the work the soil to perform a weed killing function. The opener 10 features a central body 12 having a hollow delivery portion 14 that is somewhat triangular or wedge-like shape when viewed from the side of the opener, is relatively narrow in a

transverse direction of the opener and has a sloped rear end or edge 16 arranged at an upper portion 17 thereof for fastening to the leading side of a C-shank near the lower end thereof so that the delivery portion 14 extends forward and downward from the shank. A solid opening or ground-engaging portion 18 of the central body 12 is fixed to a front end of the delivery portion 14 to extend forward therefrom over a substantially the full height of the delivery portion 14. A sweep 20 is defined near a bottom end of the central portion 12 by a pair of wings 22 projecting laterally outward from opposite sides of the central portion 12 in a reward direction from near a tip or point 24 formed at the forwardmost and lowermost point of the opener 10.

Seed and fertilizer can be delivered through separate channels 26, 28 formed by division of the delivery portion's hollow interior as shown in Figure 4. Outlets 26a, 28a of these channels 26, 28 are formed above the bottom of the opener between the rearwardly swept wings 22 in a transverse direction extending laterally across the opener as shown in Figure 3. The outlets 26a, 28a are formed forward of the rear edge upper portion 17 at which the delivery portion 14 is adapted for connection to the C-shank so that seed and fertilizer is released into the furrow formed by the opener before the soil displaced thereby is able to close back in behind the shank being pulled past the displaced soil. Tungsten carbide inserts are installed along the front sides of the sweep wings 22 to increase the durability of the otherwise steel opener and reduce or prevent wear or damage to the wings 22 themselves. The point or tip 24 of the opener is similarly defined by a tungsten carbide insert to protect the lowermost point on the ground engaging portion 18 of the opener.

In the figures, the opener 10 is shown generally in the position in which it is to be used when installed on a seeder or drill, that is, with the leading or forward edges defined on the wings 22 that define the cutting edges of the sweep 20 situated in a common horizontal cutting plane along which the opener is to be pulled when installed on the seeder or drill for use. The central body 12 is disposed in a central vertical plane bisecting the angle at which the sweep wings 22 horizontally diverge and defining their plane of symmetry, the width of the central body 12 being measured perpendicularly across the central vertical plane and being significantly less that the central body's dimensions measured horizontally and vertically along this vertical plane such that front, rear, top and bottom boundaries or perimeter sections of the central body 12 in this vertical plane may be thought of as being defined by ends or edges of the central body, which are herein referred to as such due to their small dimensions in the width or transverse direction of the opener through the vertical plane relative to the dimension of the laterally facing sides of the central body 12 along the central vertical plane. A forward working direction in which the opener is to be pulled can thus generally be though of as extending along the intersection of the horizontal cutting plane and the central vertical plane from the opener's point 24 away from the rest of the opener, or other directions parallel to this, for example a horizontal distance from a rear end of the central body to a forward end thereof in the central vertical plane.

The laterally facing sides 32 of the hollow delivery portion 14 of the central body are defined on opposite sides of the central vertical plane by a contoured steel plate that also defines a vertically oriented curved front edge 34 of

the hollow delivery portion curving 180 degrees about a vertical axis to integrally connect the lateral sides 32 over their full height. This curved front edge 34 extends upward past the lateral sides 32, where, with the same arcuate curvature, it extends through nearly a full 360 degrees about the same vertical axis to define a seed tube 36 projecting upward from the delivery portion 14 of the central body 12 over an open top end thereof defined between the lateral sides 32. At a distance above the lateral sides 32 of the delivery portion 14, a seed hose clamping slot 38 is defined in the seed tube wall to extend therethrough over an approximately 180 degree span therearound at a position opposite the curved front edge 34 and passing through a vertical slot 40 left by the slightly less than 360 degree periphery of the seed tube 36. The seed tube 36 has a diameter suitable to receive the free discharge end of a seed hose of the seeder or drill through the seed tube's open top end 42. With a seed hose so inserted, the seed tube 36 closes nearly fully around the seed hose above and below the seed hose clamping slot 38. A hose clamp previously fitted around the seed tube 36 or seed hose is positioned around the seed tube 36 at the seed hose clamping slot 38 and tightened around the seed hose through this slot to clamp the seed hose in place against the curved front edge 34 of the seed tube 36.

As shown in Figure 4, extending downward from proximate the bottom of the seed tube 36 and the open top of the delivery portion 14 of the central body 12 is a divider plate 44 projecting generally vertically downward from proximate a rear side of the seed tube 36 and extending generally fully between the lateral sides 32 of the hollow delivery portion 14 to define a generally vertical seed channel or passage 26 between itself and the curve front edge 32. The seed tube 36 projecting upward

from the central body 12 at the open top of the hollow delivery portion 14 thus defines a seed inlet through which seed delivered through the seed hose of the seeder or drill passes into the seed channel 26 defined in the hollow interior of the delivery portion by the lateral sides 32, curved front edge 34, and divider plate 44.

With reference to Figures 3 to 5, an outlet chamber 46 is mounted beneath the hollow delivery portion 14 of the central body in a position beneath the seed channel 26. The outlet chamber 46 features a curved vertical front wall 48 positioned beneath the front edge 32 of the hollow delivery portion 14 in general vertical alignment therewith to define a curved front portion 49 of the outlet chamber's hollow interior. Vertical side walls 50 of the outlet chamber 46 extend rearward from this curved front portion of the chamber in a diverging manner at an angle corresponding to rearwardly diverging angle of the symmetrical sweep wings 22, the outlet chamber itself being positioned between the wings 22 in the transverse direction across the opener. Each of these side walls 50 of the outlet chamber 46 is recessed slightly into a rear side 52 of the respective one of the sweep wings 22 at a notch formed therein along the rear side 52 adjacent the central body 12, so that a remaining portion 52a of the wing's rear side 52 left intact rearward of the outlet chamber's side wall 50 aligns with the side wall 50.

A bottom plate 54 of the outlet chamber 46 extends between the side walls 50 beneath the seed channel 26 to connect them at their bottom ends and define a floor or bottom of the chamber 46. On each side of the central body 12, a cover plate 56 projects laterally outward therefrom directly over the bottom plate 54 past the respective side wall 50, sloping downward in the forward and laterally

outward directions for connection to a top surface of the respective sweep wing 22, thereby defining a cover or top of the outlet chamber 46. The top of the outlet chamber 46 is left open between the laterally facing side walls 32 of the hollow delivery portion 14 of the central body 12 so that the open bottom of the seed channel 26 communicates with the open top of the seed outlet chamber 46. A rear end of the outlet chamber 26 has a central vertical wall 58 positioned beneath the lateral side walls 32 of the hollow delivery portion 14 of the central body 12 at the rear of the seed channel 26. At this rear wall 58 of the outlet chamber 46, the divider wall 44 from the hollow interior of the delivery portion 14 of the central body 12 depends downward below the side walls 32 thereof and attaches in a face-to-face manner with the rear wall 58 of the seed outlet chamber 46 at the rearwardly facing surface thereof.

The rear wall 58 of the outlet chamber 26 extends slightly beyond each lateral side 32 of the hollow delivery portion from the divider plate 44 therebetween in the transverse direction across the opener 10, leaving an outlet opening 26a on each side of the hollow delivery portion of the central body 12, laterally outward from the central body 12 between the hollow delivery portion 14 thereof and the respective sweep wing 22. At the rear of the outlet chamber, its bottom plate 54 is positioned at an elevation generally equal to that of a bottom edge 52b of the horizontally extending rear end 52 of the sweep wing 22, so that the respective seed outlet 26a bounded by the chamber's bottom plate 54, respective side wall 50, central rear wall 58 and respective cover 56 is open at and somewhat above the height of the sweep wing's rear end 52. Each cover plate 56 and the respective

portion of the bottom plate 54 positioned therebeneath have their rear edges sloping obliquely in the forward direction as they extend laterally outward away from the central body 12, so that the respective seed outlet opening 26a is similarly angled to give the seed discharged therefrom rearward and laterally outward components of motion to encourage better separation of seed released from the two outlets 26a in the transverse direction. With the opener 10 installed on the shank of a seeder or drill with the seed hose thereof inserted into the seed tube 36 of the opener 10, seed is delivered downward through the seed tube 36 and the seed channel 26 of the delivery portion 14 into the outlet chamber 46 for subsequent discharge through the seed outlets 26a on either side of the opener's central body 12 onto the seed shelf formed a short distance below these outlets by the sweep 20.

A removable top cover 60 closes the open top end of the of the hollow delivery portion 14 of the central body 12 immediately behind the seed tube 36 rearward to the rear end 16 of the central body 12, as defined by the rear end of the hollow delivery portion 14 thereof, sloping downward in the forward working direction from the open top down to the bottom of the seed channel 26. The top cover 60 has a curved or bent top portion 62 arching across the open top from one lateral side 32 of the delivery portion 14 to the other. At each of its sides where it extends along the top edge of a respective one of these side walls 32, the top cover 60 curves back inward beneath itself toward the central vertical plane for a small distance before bending the opposite direction to create a downwardly depending vertical side wall 64. The bent sides of the top cover 60 define ledges 65 projecting laterally outward from the rest of the top cover 60 to sit atop the top edges of the side walls 12 of the

hollow delivery portion 14 of the central body 12 to position the cover's side walls 64 inside the hollow delivery portion 14, depending downward along the inner surfaces of its lateral sides 32.

The rear edge 64a of each side wall 64 of the top cover 60 is sloped to extend downward in the forward working direction at the same angle as the rear end 16 of the hollow delivery portion 14. A forward end 62a of the cover's top portion 62 projects past the forward ends of its side walls 64 and arcs horizontally to accommodate the rear end of the seed hose, as this forward end 62a projects slightly into the seed channel 26 just below the seed tube 36 between a pair of shoulders 68 of the side walls 32 of the hollow portion 14 of the central body, each shoulder 68 projecting above the rest of this side wall 32 where the seed tube connects thereto. The shoulder 68 and the divider plate 44 of the hollow delivery portion 14 of the central body form a stop past which the top cover 60 cannot pass in the forward working direction, thus positioning the top cover 60 in a position spanning from the seed tube 36 to the rear end 16 of the central body's hollow delivery portion 14 at the open top thereof. A cover opening 66 left in the rear facing side of the seed tube 36 directly above the shoulders 68 spans the seed tube's full diameter just above at this rear side to accommodate the projecting front end 63a of the top cover 60 during insertion thereof by lowering of the cover's vertical side walls 64 into the open top of the delivery portion 14 rearward of the seed tube 36 and simultaneous sliding of the cover 60 in the forward direction until the ledges 65 sit atop the delivery portion's side walls 32 with the cover's front end disposed between the shoulders 68 thereof.

A circular hole 70 in the top portion 62 of the top cover 60 features a fertilizer tube 72 passing downwardly through the top cover 60 into the hollow interior of the central body's delivery portion 14 just rearward of the seed tube 36. Like the seed tube, the fertilizer tube is formed of plate material bent through nearly 360 degrees to form a nearly closed cylindrical structure, leaving a narrow gap 74 in its circumference extending along the nearly vertical cylindrical-like tube on its rearward-facing side. A fertilizer hose clamping slot 75 is defined in the fertilizer tube 72 proximate the open top 76 thereof, extending through its peripheral wall over an approximately 180 degree span thereabout at a forward facing side of the seed tube opposite the gap or vertical slot 74. The fertilizer hose of a seeder or drill can therefore be clamped in place in the same manner as described herein above for the seed hose, but against the rear side of the fertilizer tube due to the positioning of the fertilizer hose clamping slot 75 in the front side thereof.

A bottom portion 78 of the fertilizer tube 72 situated beneath the top cover 60 within the hollow interior of the central body's delivery portion 14 between the side walls 32 thereof arcs only through 180 degrees, defining a U-shaped portion curving about the same axis as the generally cylindrically shaped upper portion 80 of the fertilizer tube 72. The U-shaped bottom portion 78 defines a pair of parallel legs 82 projecting rearward from the upper portion 80 therebeneath at opposite sides thereof. These legs 82 are positioned parallel to and between the top cover's side walls 64 and the side walls 32 of the central body's hollow delivery portion 14. Aligned holes 84 defined horizontally through the legs 82 are positioned to align with a similar pair of aligned holes defined horizontally through the top cover's side walls

64. Yet a further pair of aligned horizontally-extending through holes 86 are defined in the side walls 32 of the central body's hollow delivery portion 14 so that when the top cover 60 is lowered into place to cover the open top of the delivery portion 14, the three pairs of holes align to allow passage of a bolt through them for fastening with a nut on an opposite side of the central body 12 to lock the top cover 60 and fertilizer tube 72 in place on the central body 12.

The rear end 16 of the opener's central body 12, sloping downward and forward from the rear end of the open top of the hollow delivery portion 14 to the divider plate 44 at the rear side of the seed channel bottom is left open adjacent the divider plate 44 on the side thereof opposite the seed channel 26 beneath a portion of the fertilizer tube's open bottom end. This defines a fertilizer channel or passage 28 within the hollow delivery portion 14 of the central body 12, extending from the bottom portion 78 of the fertilizer tube 72 downward through the hollow interior of the delivery portion 14 on a side of the divider plate 44 opposite the seed channel 26 to the fertilizer outlet 28a defined by the open portion of the central body's rear end 17 beneath the fertilizer tube 72.

Granular fertilizer delivered to the fertilizer tube 72 through a respective delivery hose to fall through the open bottom end of the fertilizer tube defined between the legs of its U-shaped portion 78, is encouraged along a generally straight path down toward the fertilizer outlet 28a by a guide bar 88 shown in Figure 4. A top end of the guide bar 88 is bent through 180 degrees to define a U-shaped hook 88a that engages around the circumferential edge of the fertilizer tube's open top end 76. From this hook end 88a, the guide bar 88 depends

generally vertically downward through the fertilizer tube 72 against the interior surfaces of its rear side to extend substantially fully down to a rear plate 90 closing off the rear end 16 of the central body's hollow delivery portion 14 rearward and upward of the fertilizer outlet 28a. The guide bar 88 is of a width sufficient to cover a significant portion of the width of the delivery portion's hollow interior, defined by the distance between the side walls 32 thereof perpendicular to the central vertical plane, to block granular fertilizer from passing rearward past it during delivery through the fertilizer tube 72. The fertilizer tube 72 projecting upward from the central body 12 at the open top of the hollow delivery portion 14 thus defines a fertilizer inlet through which fertilizer delivered through the fertilizer hose of the seeder or drill passes into the fertilizer channel 28 defined in the hollow interior of the delivery portion by the lateral sides 32, guide bar 88, and divider plate 44.

The sloping of the rear end of the hollow delivery portion 14 of the central body 12 gives the fertilizer outlet 28a, bound by the side walls 32, divider plate 44 and rear plate of the delivery portion 14, a downward and rearward facing orientation. The positioning of the outlet in the rearward and downward facing end 16 of the central body 12 situates it between and above the seed outlets 26a defined by the seed outlet chamber 46. This arrangement is similar to paired row seed delivery, with seed being discharged at laterally spaced positions through the seed outlets 26a to define two somewhat distinct seed rows, and same-plane fertilizer delivery with a central row of granular fertilizer delivered between these seed rows through the fertilizer outlet 28a on the same bed formed by the horizontal cutting plane of the sweep 20.

The rear plate 90 extending along the rearward and downward facing end of the opener's central body 12 above and rearward of the fertilizer outlet 28a generally closes off the rest of the delivery portion's hollow interior except for two fastener openings 92, 94 spaced apart near an upper end of the rear plate 90 rearward of the fertilizer tube 72. The slope of the rear plate 90 and the rear end 16 of the opener's central body, especially at this upper portion 17, approximates that of the lower end portion of a typical C-shank of an agricultural implement so that this upper portion can rest against the shank's lower portion on the forward facing side thereof, with the fastener holes 92, 94 being aligned with the shank's existing fastener elements to facilitate fastening of the opener thereto with the top cover 60 removed for access to the interior side of the fastener holes 92, 94. The lower fastener hole 94 is an elongated slot extending along the sloped rear end 16 to accommodate varying spacing of fastener elements along the shank from one brand of implement to another. It will be appreciated that the central body could be modified for use with other shank styles. For example, a vertical edge-on shank could depend downward between the side walls of the delivery portion at a section thereof left open between the side walls rearward of fertilizer tube channel for fastening to the shank through suitably positioned holes in the side walls 32.

As shown in Figure 4, the ground engaging portion 18 of the opener 10 fixed to the front edge 34 of the hollow delivery portion 14 is solid to provide greater strength at the leading or forward end of the central body 12. This solid portion 18 projects fowardly from the delivery portion 14 over the full height thereof, sloping downward and forward from the front edge 34 of the delivery portion proximate the

shoulders 68 from which the seed tube 36 projects further upward. This provides a significant span of solid material forward from the hollow delivery portion 14 at the bottom thereof to provide strength, but avoids the creation of a large ledge that would project forward from the top of the delivery portion 14 if a right angle arrangement having a straight top and front end were instead used for the solid portion 18. Although such a completely vertical front end may be used with the intention of being able to better cut through trash or debris below its top end during pulling through the soil, weeds, grass and trash may tend to become hung up on the generally horizontal straight cut off or ledge when the opener is lifted. To retain a high degree of smooth passage through crop residue while keeping such hang up issues low, the different planar sections of the front end of the illustrated opener embodiment are each oriented at angle greater than fifty degrees, and more particularly between approximately sixty and ninety degrees, measured in the central vertical plane from the horizontal cutting plane in the forward working direction.

In addition to avoiding the creation of a significant horizontal ledge, the use of non-vertical sloped sections extending downward and forward at the front of the opener acts to encourage the exertion of downward force on the opener as it is pulled through the soil, as the pressure or normal force exerted on these sloped faces or surfaces by the earth above and in front of them as they are pulled through the soil has a vertically downward component. This downward pressure provides a sucking-like action tending to force the opener downward and keep it engaged in the earth at a suitable depth below the surface. The relatively steep angles of the sloped front of the opener thus provide a good balance between the ability to cleanly

pass through trash or debris with little hang up thereof and the exertion of some downward force on the opener as it is pulled through the earth.

In the illustrated embodiment the front portion 18 is defined by two distinct solid parts that have been fixed together by welding, but those of skill in the art will appreciate from the following description that it may have other constructions, for example formed of a single integral piece. The first or rear part 96 is welded to the curved front edge 34 of the delivery portion 14 to extend upward therealong from a bottom end flush with the bottom of the seed outlet chamber 46 to the shoulders 68 of the delivery portion side walls 32.

As shown in Figure 4 with broken lines representative of imaginary boundaries, the cross-sectional shape of the rear part 96 of the solid portion 18 when cut along the central vertical plane can be described as the sum of three components. A long thin rectangular component 96a extending along the front edge 34 of the delivery portion has its thin dimension extending forward therefrom to present a narrow horizontal ledge 98 at its top end on which welding/hardsurfacing 100 connects to the delivery portion 14 and maintains a downward and forward slope from the delivery portion front wall 34 to the rest of the solid portion 18 forward of the long thin rectangular component 96a. A triangular component 96b forms a scalene right angle triangle having its longer leg extending along the front side of the thin rectangular portion 96a downward from the ledge 98 with its shorter leg situated at its bottom with the hypotenuse forming the downward and forward sloping forward-facing surface of this triangular component 96b. A thicker rectangular component 96c completes the first part 96 of the solid portion, extending downward

along the front side of the thin rectangular component 96a beneath the full width of the triangular component 96b to the bottom end of the thin rectangular component 96a.

With reference to the same cross sectional view of Figure 4, the second or front part 102 of the front portion 18 is fixed to the front side of the thicker rectangular component 96c of the rear part 96, extending from the bottom thereof upward to a point spaced downward from the top end thereof, thereby leaving a small portion 104 of the thicker rectangular component's vertical front side exposed in the forward working direction. Another narrow horizontal ledge 106 is defined by the top end of the front part 102, with the corner between this second ledge 106 and the exposed vertical portion 104 having welding/hardsurfacing 108 thereatop to create a slope between these surfaces to avoid an exposed horizontal surface. From the second narrow ledge 106, the front part 98 slopes downward and forward along an upper component 102a of the front part 102, broken lines again being used as imaginary boundaries to divide the cross sectional shape of the part. A lower component 102b disposed beneath the upper component 102a and also connecting to the front side of the first part's thicker rectangular component 96c, has its front side recessed slightly rearward from that of the upper part 102a and sloping downward and forward at a steeper, but non-vertical, angle relative to the horizontal cutting plane. The bottom of the lower component 102b is situated below the bottom of the first part 96 at the lower component's forward side, but at the generally the same elevation as the bottom of the first part 96 at its rear end connected thereto, the bottom of the lower component extending first horizontally rearward from its front

side and then curving upward and rearward toward its rear to create a downwardly and rearwardly concave transition 110.

In the illustrated embodiment, the forward and upward facing sloped front surface of the triangular component 96b of the rear portion 96, extending along its hypotenuse, and the forward and upward facing sloped front surface of the upper component 102a of the front portion 102 are each oriented at an angle of approximately sixty-five degrees to the horizontal cutting plane. The forward and upward facing sloped front surface of the lower component 102b of the front portion 102 is oriented at an angle of approximately eighty degrees relative the horizontal cutting pane, with the exposed portion 104 of the forward facing front surface of the thicker rectangular component 96c of the rear portion 96 being at an angle of approximately ninety degrees to the horizontal cutting plane.

At the bottom of the front side of the lower component 102b of the front part 102 of the solid portion 18, a carbide tungsten point 112 is fixed to the front side to define the forwardmost point 24 of the opener to give the point a greater hardness than the steel body on which it is mounted. The carbide point 112 narrows in the forward working direction from an integral flat rectangular base portion 112a of the point, which is braze welded to the front side of the front part's lower component 102b in a face-to-face arrangement, to a central narrow rectangular forwardmost surface extending generally parallel to the front side of the front part's lower component 102b. The carbide point 112 also narrows in a downward direction from the integral base portion 112a where it extends forward from a lower edge of this rectangular base portion 112, narrowing in the downward direction to a generally

horizontal center bottom surface disposed beneath the narrow forwardmost surface. This central bottom surface is symmetrical about the central vertical plane and frustotriangular in shape, narrowing from the front side of the lower component 102b of the front part 102 of the solid portion 18 of the central body beneath the base portion of the carbide point 12 to the truncated end of the surface's frustotriangular shape intersecting with, and having its width defined by, the forward facing narrow rectangular surface. Each of the front and bottom sides of the carbide point has three flat surfaces: a central surface perpendicular to the central vertical plane, and a pair of outer surfaces on opposite sides thereof converging theretoward; the outer surfaces of the bottom side extending forward from the front side of the lower component 102b of the central body 12 and the outer surfaces of the front side extending forward from the side of the point's rectangular base 112a opposite its connection to the front side of that lower component 102b.

Also braze welded to the front side of the front part's lower component 102b immediately above the carbide point 112 is a flat rectangular tungsten carbide wear plate 114 arranged face-to-face with this front side, having a thickness similar to the rectangular base portion 112a of the carbide point 112. This thickness of the carbide wear plate 114 is generally equal to the depth by which the front side of the front part's lower component 102b is recessed back from the front side of the front part's upper component 102a, the carbide wear plate and point substantially filling the full height of this recessed portion of the opener's front side. On the front side of the front part's upper component 102a, just above the lower component 102b, three hardsurfacing strips 116 are provided extending across the front side in the

transverse direction of the opener in closely spaced proximity to one another along the sloped front side. The carbide wear plate and tip and this hardsurfacing provide an area of improved strength extending upward from the bottom of the opener's front side in this area thereof that must endure the most punishment, for example colliding head-on with rocks disposed in the soil, during pulling of the opener through the earth relative to the otherwise steel structure alone, and in addition allow for repair by re-hardsurfacing to reduce or eliminate the need to instead replace the opener after extended use.

The sweep wings 22 are fixed to opposite flat lateral sides of the solid portion 18 of the opener's central body 12 parallel to the central vertical plane on opposite sides thereof by welding of their inner ends to these opposite sides forward of the seed outlet chamber 46. The wings 22 are further secured to the seed outlet chamber 46 along the side walls 50 thereof and front edges of the chamber's cover plates 56 at the recessed or notched inner portion of each wing's rear side 52, the rear side referring to a surface defined by the wing's thickness and facing rearward and inward toward the vertical central plane. Welding/hardsurfacing connects the chamber's cover plates 56 to the wings, filling vertical space between an upper surface 118 of each wing 22 and the respective cover plate 56 of the seed outlet chamber 46 along the respective side wall 50 thereof to avoid a forward-facing vertical projection above the wing's top surface 118 and instead form a rearward and upward slope from the wing to the top of the seed outlet chamber 46.

The thickness of each plate-like wing spaces apart the upper surface 118 thereof from a bottom surface 120 of the wing, the rear side 52 of the wing

extending generally perpendicularly between these two surfaces. Relative to the horizontal cutting plane, each wing 22 slopes upward from its generally horizontally extending front side to its generally horizontally extending rear side 52. The bottom surface 120 of the wing is generally flush with the bottom of the front part 102 of the solid portion 18 of the central body 12 at the wing's front side and extends rearward to a height generally equal to that of the bottom plate 54 of the seed outlet chamber 46 at the seed outlet 26a thereof at the wing's rear side 52. The front side of each wing is not perpendicular between the top and bottom surfaces thereof like the rear side, instead sloping forward and downward from the top surface 118 to the bottom surface 120 at an oblique angle relative to these surfaces, thereby presenting a forward and upward facing front side of the wing 22.

A plurality of tungsten carbide inserts 122 are braze welded at flat faces thereof to the sloped front side of each wing 22 in an end-to-end arrangement therealong. In the illustrated embodiment, each wing has four inserts 122, each being a parallelepiped having elongated non-right-angle parallelogram faces interconnected by rectangular joining surfaces perpendicular to these faces and defining a thickness of the insert less than its length and width as defined by its faces. The inserts extend lengthwise along the front side of the wing 22 spanning substantially the full width thereof between the upper and lower wing surfaces. The rearward sweeping angle of each wing 22, its sloped front side and its generally parallel ends, the inner one of which is fixed generally flush against the vertical side of the central body's solid portion, gives the front side a parallelogram shape when viewed face on, the inner end of the front side angling rearward along the vertical

side of the central body 12 at the wing's inner end. The small angle of the parallelogram face of each insert 122 is chosen to generally match this angle to align therewith, the total length of the three inserts matching the length of the wing's front side so that the three inserts substantially cover the full front side of the respective wing 22 when arranged end-to-end therealong in aligned orientation therewith. With the inserts so positioned, the cutting edges of the sweep 20 are thus defined on each wing 22 by the aligned bottom edges of the exposed forward faces of the inserts 22 situated forward of the wing's front side by the thickness of these inserts. Along the horizontal cutting plane defined by the cutting edges, the front sides of the wings are positioned slightly rearward of the bottom end of front side of the solid portion 18 of the central body at the lower component 102b of the front part 102 thereof so that that an axis along which each insert-defined cutting edge 124 extends has a bottom corner of the carbide point's rectangular base 112a, on the mounting face thereof at the side nearest the wing in question, lying on it or in close proximity to it. Together with the inner ends of the laterally innermost wing inserts 122 being generally flush with the inner end of the wing fixed to the central body 12, the carbide wing inserts 122 are thereby kept close to the carbide point 112 in both the horizontal forward working direction and the horizontal transverse direction perpendicular thereto.

Like the carbide point 112 and wear plate 114 of the opener's central body 12, the wing inserts improve the strength of the opener's sweep 20 by using harder carbide in place of the steel wing bodies to define the horizontal cutting edges. It will be appreciated that the description of the wings as being plate-like

refers to that they each have a relatively thin thickness relative to its width and length, but that the wings are thicker than most conventional agricultural sweeps typically formed by forging of relatively thin metal plate material. Although the illustrated embodiment uses four carbide inserts on each wing, it will be appreciated that this number may be varied, down to as little as one insert or up to several times the illustrated number. The use of multiple inserts per wing may be advantageous in that chipping or other damage to one insert is not detrimental to the other separate and distinct carbide pieces. For example, where producing inserts of only a single predetermined size, the number of inserts used on each sweep wing of a particular opener may be selected based on the width of that opener.

In the illustrated embodiment, the solid portion 18 of the central body 12 is of a uniform width measured in the transverse direction over its full height, the hollow delivery portion having a matching outside width over a lower portion thereof extending from the seed outlet chamber 46 upward to a horizontal plane extending through the exposed portion 104 of the front side of the thicker rectangular component 96c of the rear part 96 of the solid front portion 18. As shown in Figures 3 and 5, the side walls 32 of the hollow delivery portion 14 flare laterally outward away from one another above this horizontal plane before returning to vertical orientations to widen its hollow interior at these upper vertical portions of the side walls to accommodate the fertilizer tube and the top cover side walls 64, the tube having an inner diameter sufficient to receive conventional delivery hoses. This flared shape allows the central body 12 of the opener 10 to be kept quite narrow over most of the opener's height profile that will be lowered into the ground, thereby

keeping resistance to pulling of the central body 12 through the soil correspondingly low and allowing for relatively fast seeding. For example, prototypes of the opener embodiment described herein above have been produced with a thickness of approximately 2.5cm at the solid portion 18 of the central body 12.3

As shown in the Figures, hardsurfacing may be applied to different external parts of the primarily steel opener structure to improve impact or abrasion resistance. In the illustrated embodiment, hardsurfacing deposits are shown (a) extending along the front side of the central body 12 on the sides thereof adjacent the front end over a bottom half of the front side of the upper component 102a of the front part 102 of the central body's rigid portion, intereconnecting the three strips of hardsurfacing 116 on this portion of the opener's front end; (b) along the borders between the front part 102 of the central body's solid portion 18 and the thicker rectangular component 96c of the rear part 96 thereof at the central body's vertical sides; (c) along the borders formed between the hollow delivery portion 14 of the central body 12 and the thinner rectangular component 96a of the rear part 96 of the solid portion 18 at the central body's vertical sides; (d) fully along the front and rear edges of each of the outlet chamber's cover plates 56 with another strip extending laterally outward from the central body along the cover plate 56 between these other two hardsurfacing strips on the cover plate 56; (e) along the borders between the wings 22 and central body 12 and between the outlet chamber's cover plates 56 and the central body 12; (f) along the joints between the rear plate 90 and lateral sides 32 of the central body's hollow delivery portion 14; (g) on the lateral side of the central body's hollow delivery portion 14 along the rear end 16 thereof over the span

of the fertilizer outlet 28a formed therein; and (h) vertically upward along the rear part 96 of the central body's solid portion 18 between the harsurfacing strips at the borders between this rear part 96 and each of hollow delivery portion and the front part 102 of the solid portion 18.

Although the illustrated opener embodiment features two separate inlet tubes 36, 72 defining inlets at the top end of the hollow delivery portion 14 of the central body 12 for two separate delivery channels 26, 28 defined therein to provide a double shoot arrangement for optional simultaneous delivery of seed and fertilizer to separate regions of the same horizontal seed bed formed by the sweep 20, it will be appreciated that other embodiments could make use only a single delivery channel, for example to deliver only one of seed and fertilizer or to deliver both seed and fertilizer through a single shoot arrangement, while still providing the advantage of delivering the material into the furrow forward of the shank on which the opener is carried to provide improved seed placement consistency. The opener of the illustrated embodiment can alternatively be used for delivery out of only one of the two outlets 26a, 28a, simply by hooking up only a single delivery hose to one of the two inlet tubes 36, 72, either to the front tube 36 for paired row seed distribution or to the rear tube 72 for single row applications. It will therefore be appreciated that the delivery channels and outlets may be varied from those shown in the figures while maintaining at least one outlet positioned forward of the opener's attachment to the shank to deliver seed ahead thereof in the forward working direction. For example, the illustrated seed channel 26 could utilized with only a single outlet 26a on a single side of the central body 12, or the illustrated granular fertilizer tube and channel

could be replaced with a liquid fertilizer delivery conduit extending downward behind the seed tube through the hollow delivery portion 14 just rearward of the divider plate 44 for discharge through the opening portion in the central body's rear end that defines the granular fertilizer outlet 28a in the illustrated embodiment.

It will also be appreciated that it may be possible to modify the opener to use a removably mounted point in place of the welded point of the embodiment detailed herein above to allow for easy replacement of a worn point or tip. Similarly, it may be possible to mount the sweep wings in a removable manner to facilitate similar replacement after significant wear. The sweep width may be varied according to a desired amount of tillage, weed kill or row spacing. For example, the overall width of the opener established by the full span of the sweep wings may be varied preferably between 5 and 12 inches. Even larger of widths could of course be produced, just as the relatively narrow central body, for example in the order of 2 to 2.5 cm, can potentially allow even smaller opener widths providing a relatively narrow sweep action. It will further be appreciated that the use of inserts on the cutting edges of a sweep may be applied to sweep constructions not including a seed or fertilizer delivery body on the central body or portion of the sweep adapted for mounting to the shank of an agricultural implement. In addition, although the illustrated embodiment is described as being formed by a several steel pieces (the two-piece ground engaging portion 18 and hollow delivery portion 14 of the central body, the sweep wings 22 and the outlet chamber 46) welded together, it will be appreciated that the opener may be produced in other ways. It may be possible to

produce the opener, or at least different parts thereof for later assembly, using casting techniques.

Figure 6 shows an alternate embodiment sweep-style opener 200 having substantially the same structure as that of the first embodiment illustrated in Figures 1 to 6, but with the addition of a deflector 202 mounted to the rearward facing outside surface of the rear wall 58 of the outlet chamber 46 immediately beneath the central outlet 28a in the rear side 16 of the hollow delivery portion. A top surface 204 of the deflector slopes downward and rearward from the rear wall 58 of the outlet chamber 46 to guide material falling through the central opening 28a of the rear channel 28 rearward onto the seed shelf. This top surface 204 is beveled to additionally slope downward moving laterally outward from a center edge 206 lying the central vertical plane on each side thereof. Granular material falling onto the top surface 206 is thus deflected rearward with a significant portion also being deflected laterally outward to produce a wider spread of the material onto the seed shelf than if simply released through the central outlet 28a without such a deflector installed. As an example, the deflector may be arranged to distribute seed within a relatively consistent width of approximately 7.5 cm centered on the central vertical plane.

The deflector 202 does not distribute the granular material laterally outward from the central vertical plane as far as material delivered through the paired outlets 26a of the front channel 26 defined on opposite sides of the central outlet 28a of the rear channel 28. Connection of the seed and fertilizer hoses of the seeder or drill to the inlets of the rear and front channels respectively delivers seed to the seed shelf by way of the central outlet 28a and deflector 202 to spread the

seed over a central span of the seed shelf while delivering fertilizer to two bands spaced laterally outward from this central span of the seed shelf on opposite sides of the seed via the pair of outlets 26a laterally outward from the opener's central body 12. Compared to the opposite connection of the seed and fertilizer hoses, as described herein above with reference to the first embodiment deflector-free opener, where fertilizer is deposited centrally on the seed shelf between paired seed deposits, this seed deflecting arrangement may be more suitable for use with a narrower packer on the seeder or drill, as the packing action may not cover a sufficient width of ground to pack a paired-row seed distribution.

Since various modifications can be made in my invention as herein above described, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.

CLAIMS:

1. A sweep opener for mounting on a shank of an agricultural implement, the sweep opener comprising:

a central body having front end, rear end, top end, bottom end and opposite lateral sides and being positionable in a vertical plane to define a forward direction by a horizontal distance from the rear end to the front end and define an upward direction by a vertical distance from the bottom end to the top end;

a sweep comprising a pair of wings proximate the bottom end of the central body and projecting from the opposite lateral sides of the central body laterally outward therefrom and rearward away from the front end;

a connection element defined on the central body proximate the rear end thereof for cooperation with a corresponding connection element defined on the shank of the agricultural implement to facilitate coupling of the central body thereto; and

a delivery channel extending downward from an inlet proximate the top end of the central body to an outlet proximate the bottom end of the central body and ahead of the connection element in the forward direction.

2. The sweep opener according to claim 1 wherein the outlet of the delivery channel comprises a pair of openings defined outward of the opposite lateral sides of the central body to open rearward between the wings of the sweep above the bottom end of the central body.

3. The sweep opener according to claim 1 wherein the outlet of the delivery channel comprises an opening defined in the central body between the

opposite lateral sides thereof to open at an elevation upward from the bottom end of the central body.

4. The sweep opener according to any one of claims 1 to 3 further comprising a second channel extending downward from a second inlet proximate the top end of the central body to a second outlet defined on the central body between the opposite lateral sides thereof ahead of the connection element in the forward direction.

5. The sweep opener according to claim 2 further comprising a second channel extending downward from a second inlet proximate the top end of the central body to a second outlet proximate the bottom side of the central body ahead of the connection element in the forward direction, the second outlet comprising an opening defined in the central body between the opposite lateral sides thereof to open at an elevation upward from the bottom end of the central body.

6. The sweep opener according to claim 5 wherein the opening of the second outlet opens between and above the pair of openings of the delivery channel.

7. The sweep opener according to claim 3 further comprising a second channel extending downward from a second inlet proximate the top end of the central body to a second outlet proximate the bottom end of the central body ahead of the connection element in the forward direction, the second outlet comprising a pair of openings defined outward of the opposite lateral sides of the central body to open rearward between the wings of the sweep above the bottom end of the central body.

8. The sweep opener according to claim 7 wherein the outlet of the delivery channel opens between and above the pair of openings of the second outlet.

9. The sweep opener according to any one of claims 3, 5 and 6 to 8 further comprising a deflector carried on the central body below the opening therein to direct material discharged through said opening laterally outward from the opposite lateral sides of the central body.

10. The sweep opener according to any one of claims 3, 5, 6 and 9 wherein the opening in the central body opens downward and rearward in a sloped edge of the central body defined between the opposite lateral sides thereof and sloping downward in the forward working direction.

11. The sweep opener according to claim 10 wherein a slope of the sloped edge of the central body facilitates mounting thereof to a C-shank with an upper portion of the sloped edge adjacent the top end of the central body sitting atop and extending generally along a lower portion of the C-shank extending upward from a bottom end thereof.

12. The sweep opener according to claim 11 wherein the connection element is defined at the upper portion of the sloped edge.

13. The sweep opener according to any one of claims 2, 5 and 6 to 8 further comprising a pair of covers extending laterally outward from the opposite lateral sides of the central body to the wings of the sweep ahead of the pair of openings in the forward direction.

14. The sweep opener according to any one of claims 1 to 13 wherein the connection element of the central body comprises at least one fastener hole through which the central body is connectable to the shank by a fastener.

15. The sweep opener according to any one of claims 1 to 14 wherein the sweep is rigidly fixed to the central body.

16. The sweep opener according to any one of claims 1 to 15 wherein front edges of the sweep have inserts fixed thereto.

17. The sweep opener according to claim 16 wherein the inserts comprise a material of greater hardness than the wings to which the inserts are fixed.

18. The sweep opener according to either one of claims 16 and 17 wherein the inserts comprise tungsten carbide.

19. The sweep opener according to any one of claims 16 to 18 wherein a plurality of the inserts are fixed to the front edge of each wing to extend end-to-end therealong.

20. The sweep opener according to any one of claims 16 to 18 wherein the front edge of each wing slopes obliquely downward and forward from a top surface of said wing, the inserts being generally flat and lying face-down on the sloped front edges of the sweep.

21. The sweep opener according to any one of claims 1 to 20 wherein the wings of the sweep connect to the central body ahead of the delivery channel in the forward working direction.

22. The sweep opener according to any one of claims 1 to 21 wherein an angle at which the front end extends from the bottom end toward the top end, measured from a horizontal plane to the front end in the forward working direction, is greater than sixty degrees.

23. The sweep opener according to any one of claims 1 to 22 wherein the inlet of the delivery channel at the top end is positioned adjacent the front end, the front end sloping non-vertically downward away from the top end in the forward vertical direction.

24. The sweep opener according to any one of claims 1 to 23 wherein the central body comprises a delivery portion through which the delivery channel extends downward and a solid portion extending from the delivery portion in the forward working direction, the wings of the sweep extending laterally outward from the central body at the solid portion thereof.

25. The sweep opener according to any one of claims 1 to 24 wherein the wings of the sweep project laterally from the central body proximate an intersection of the front and bottom ends thereof.

26. The sweep opener according to any one of claims 1 to 25 wherein the central body comprises a cutting tip positioned proximate a position at which the front and bottom ends intersect, the cutting tip narrowing in the forward working direction and the sweep projecting laterally away from the central body proximate the cutting tip.

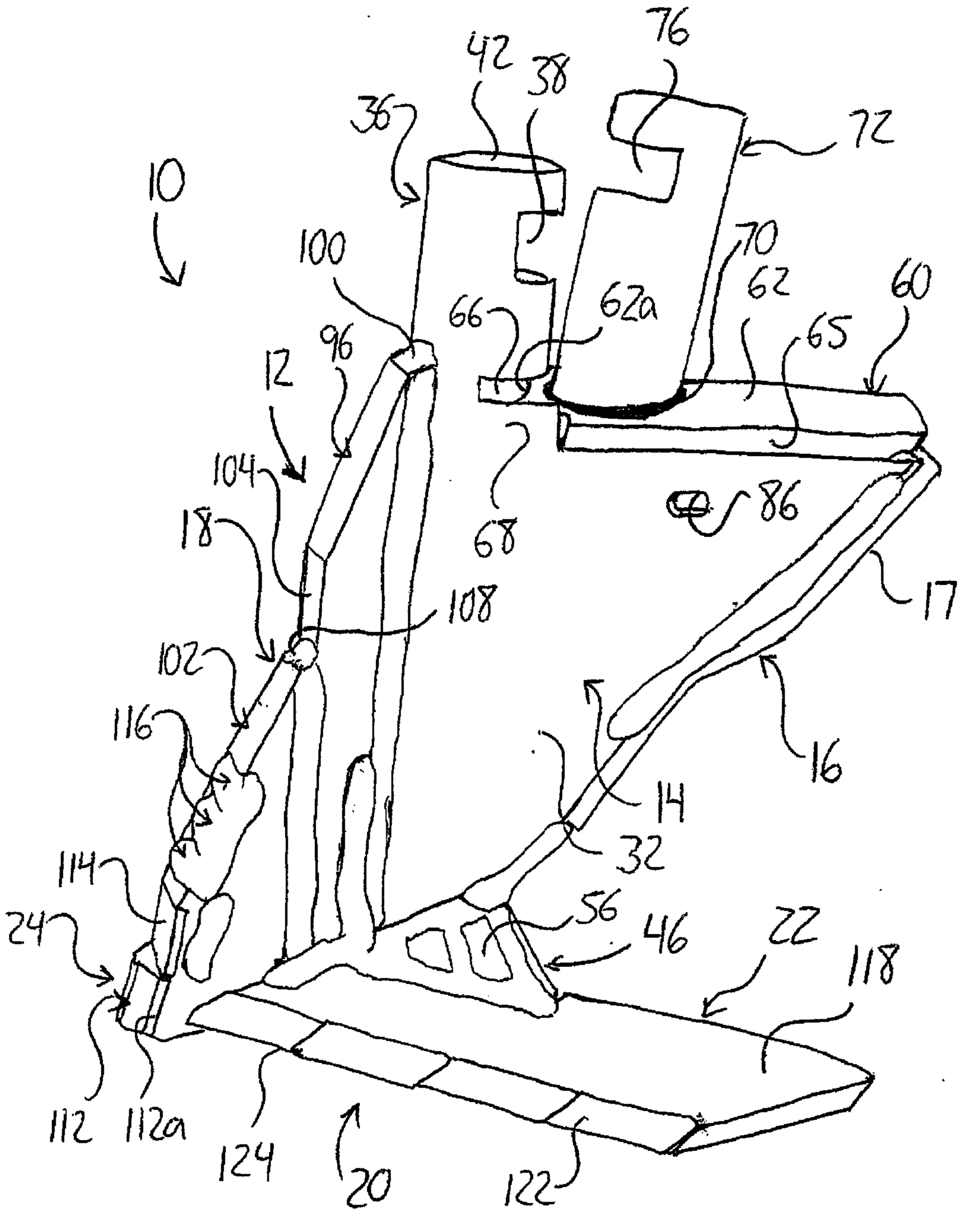
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FIG. 1

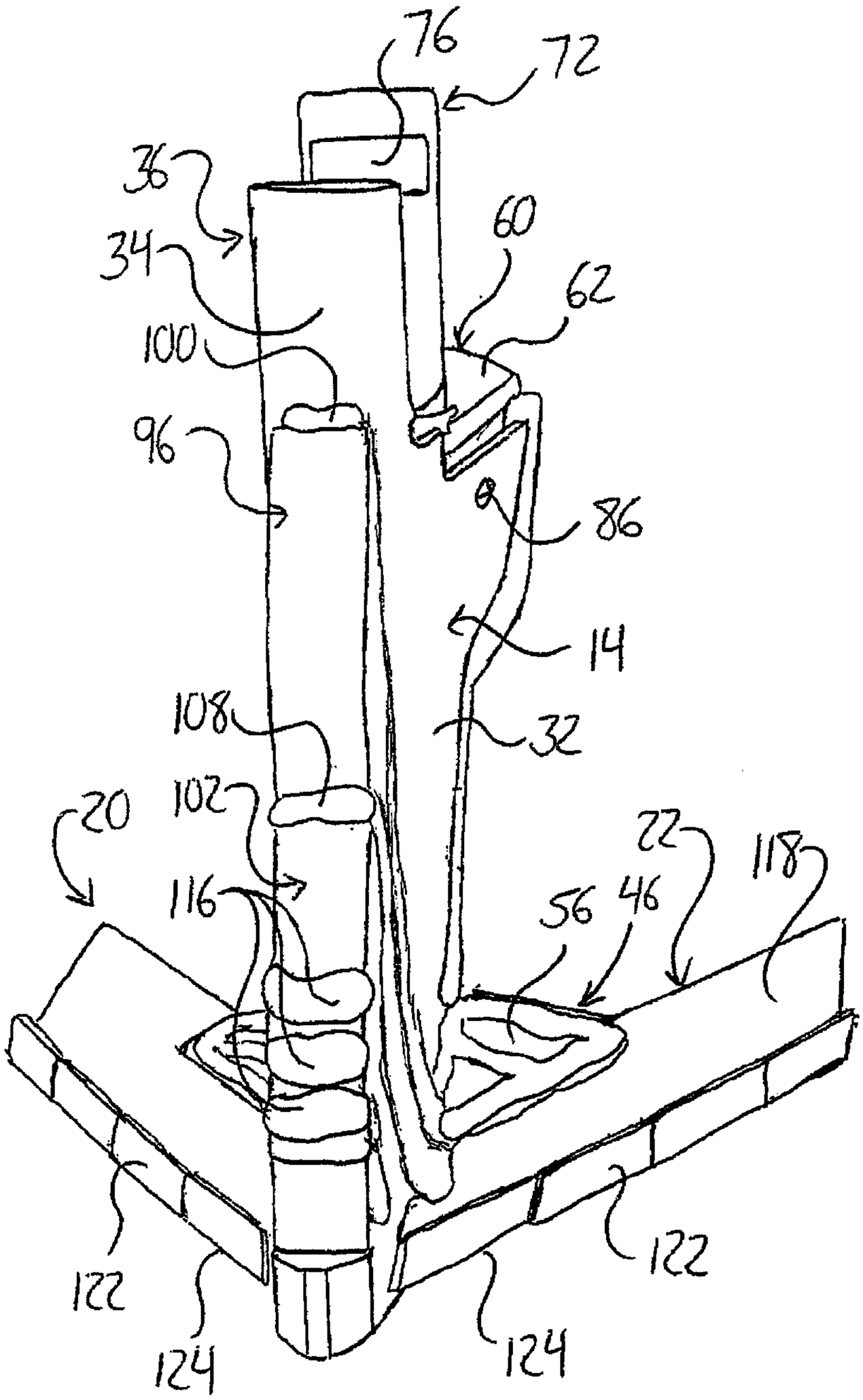
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FIG. 2

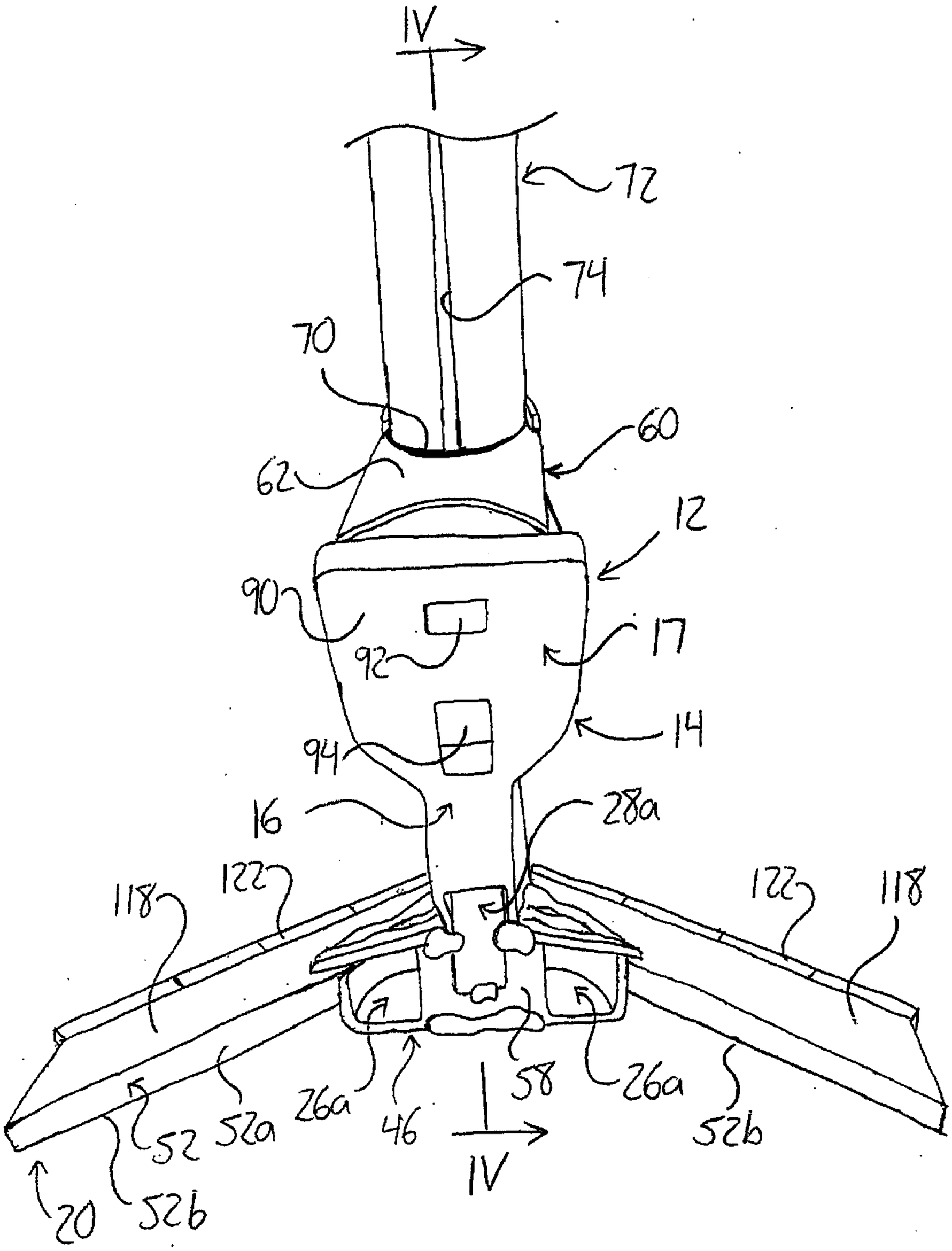
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FIG. 3

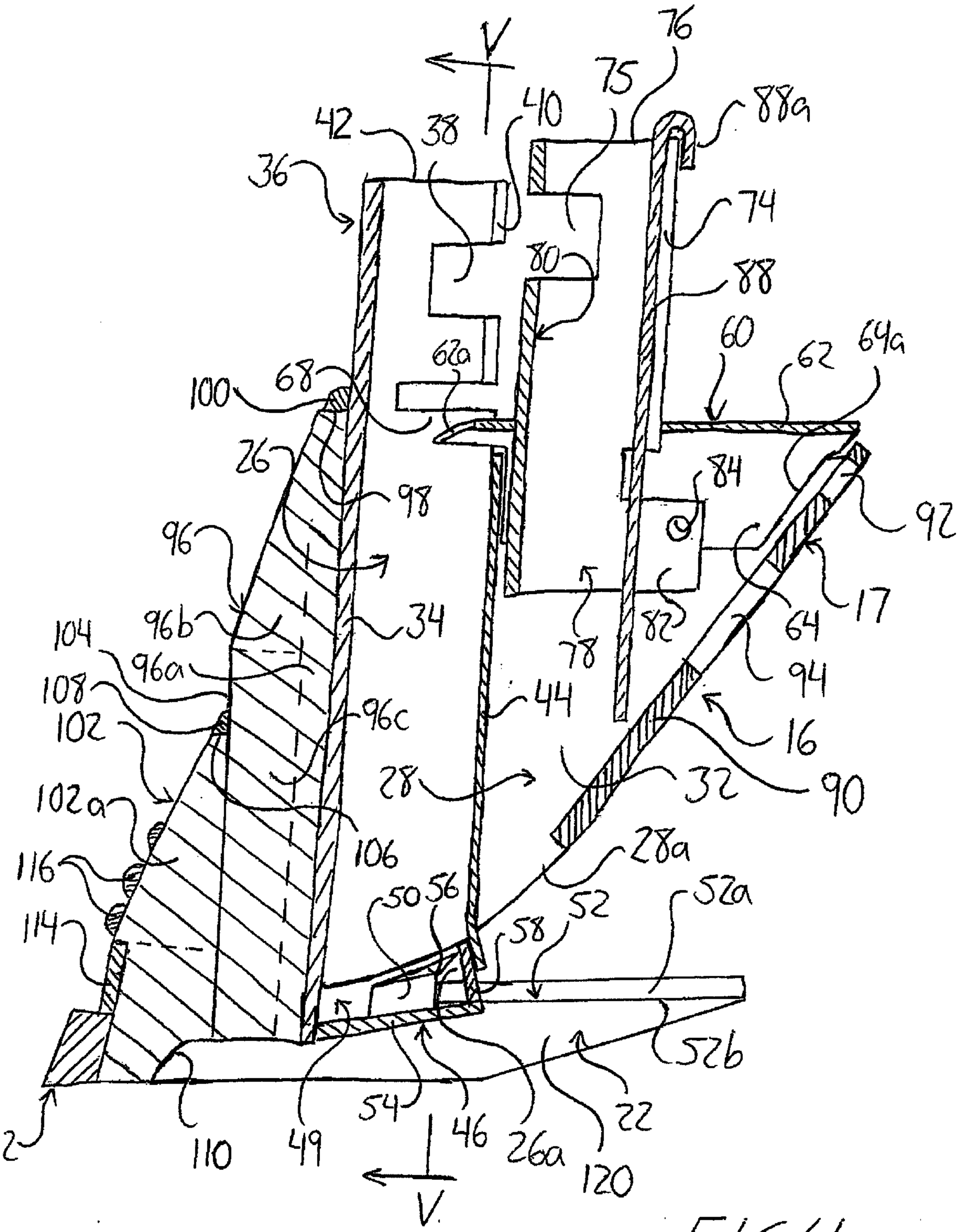
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FIG. 4

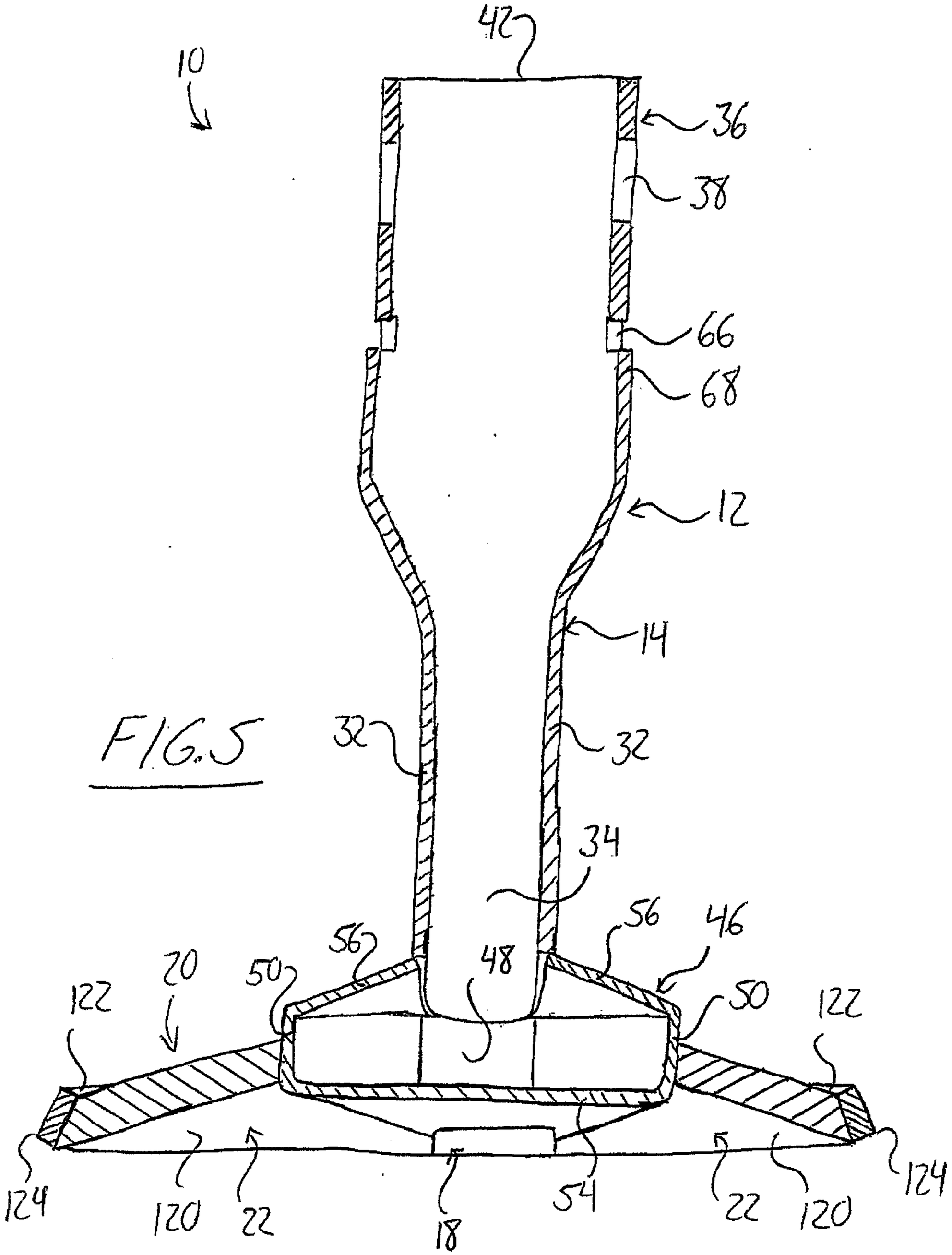
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FIG.5

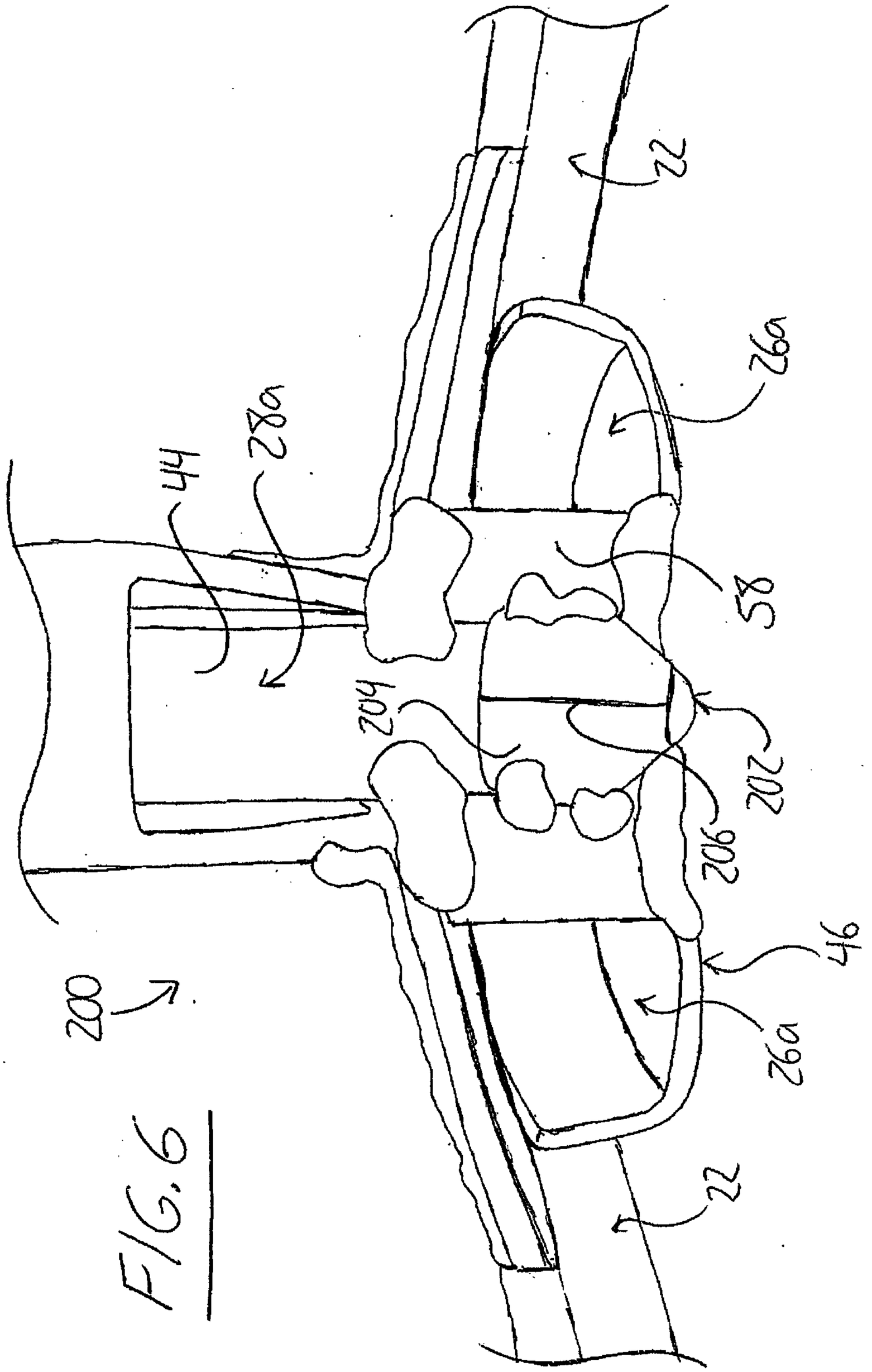
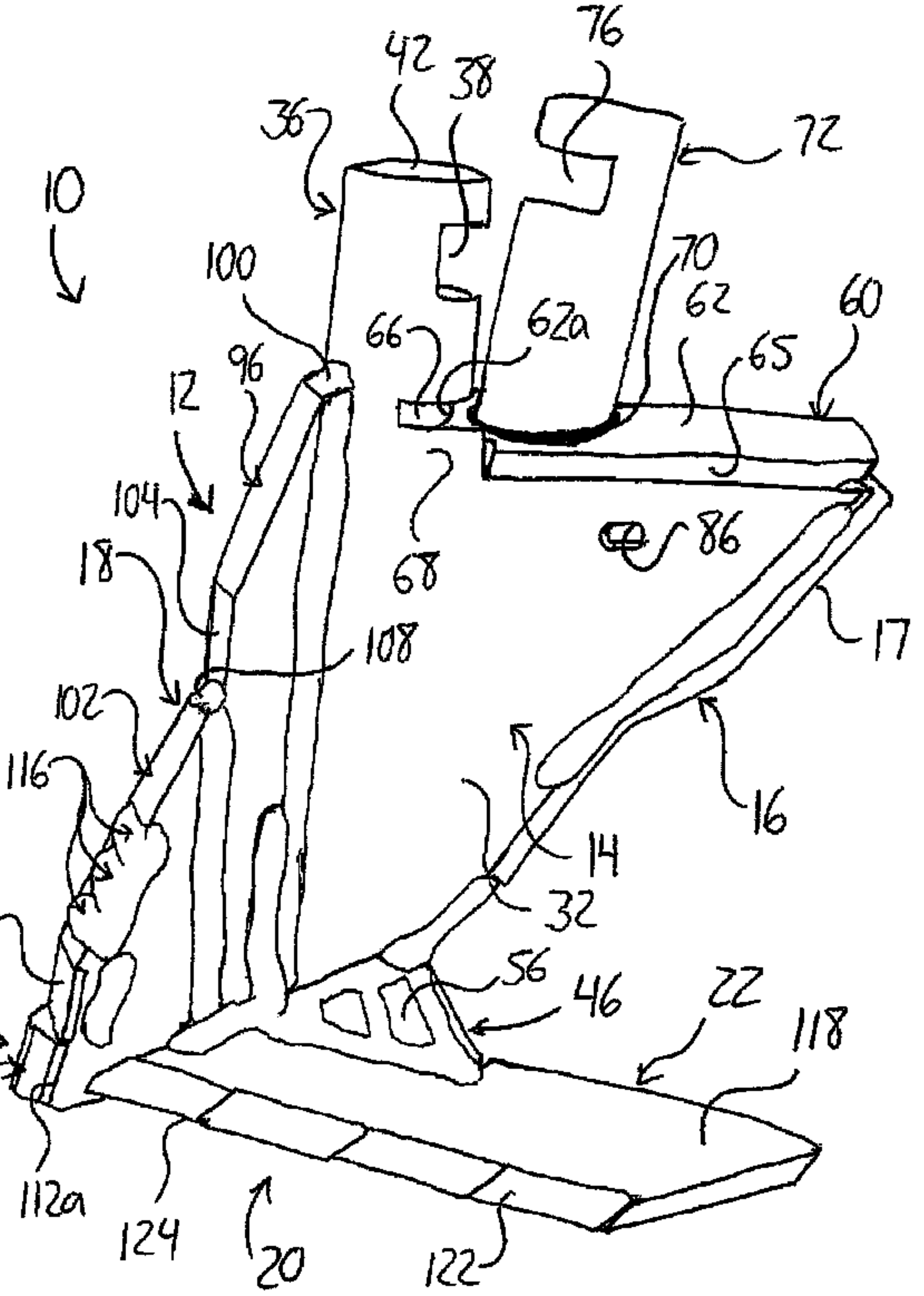


FIG. 6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