

Jan. 15, 1957

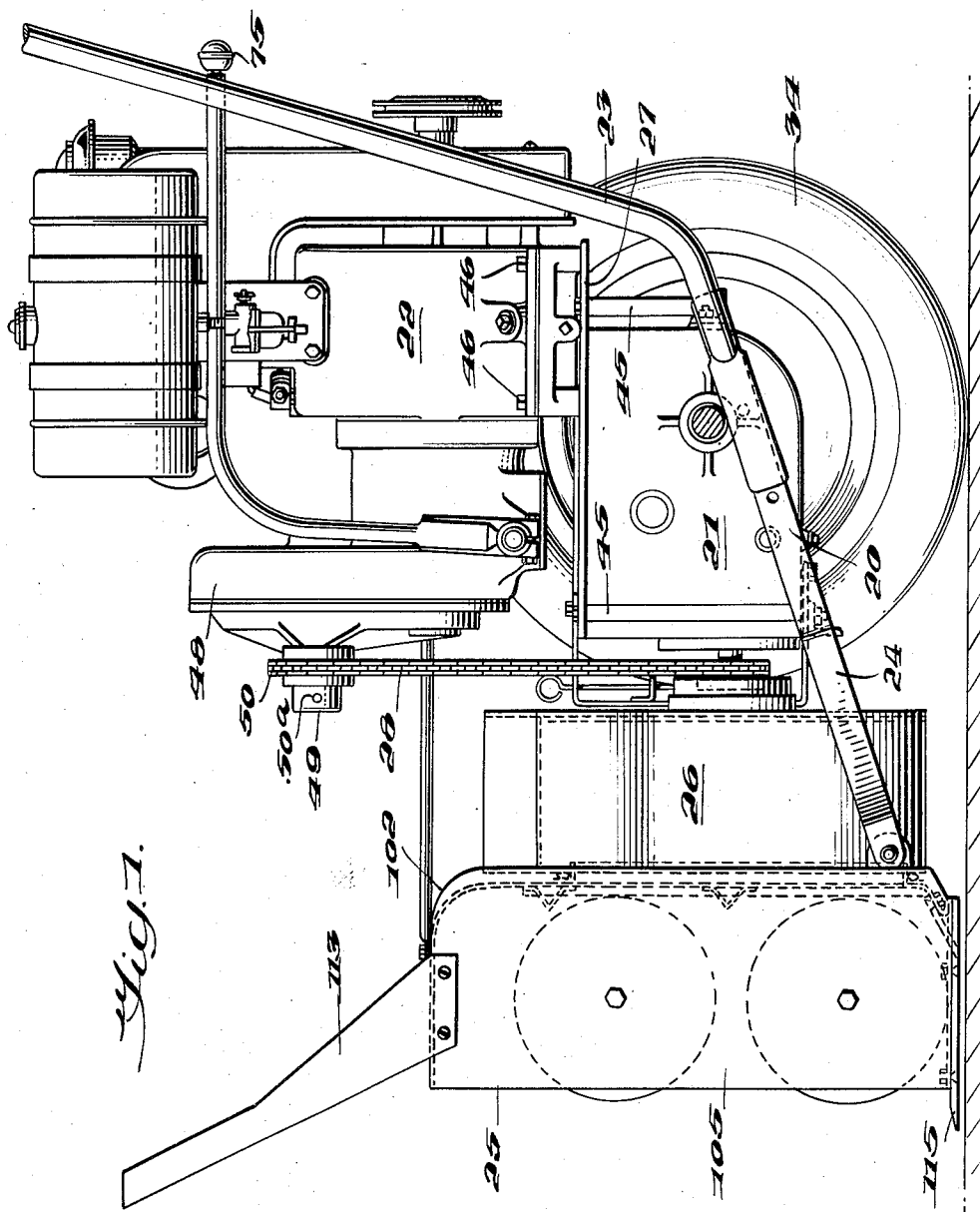
W. E. KLAUER

2,777,217

SNOW REMOVING APPARATUS

Filed Jan. 5, 1951

9 Sheets-Sheet 1



INVENTOR

WALTER E. KLAUER,

BY

Robert B. Hansen
ATTORNEY

Jan. 15, 1957

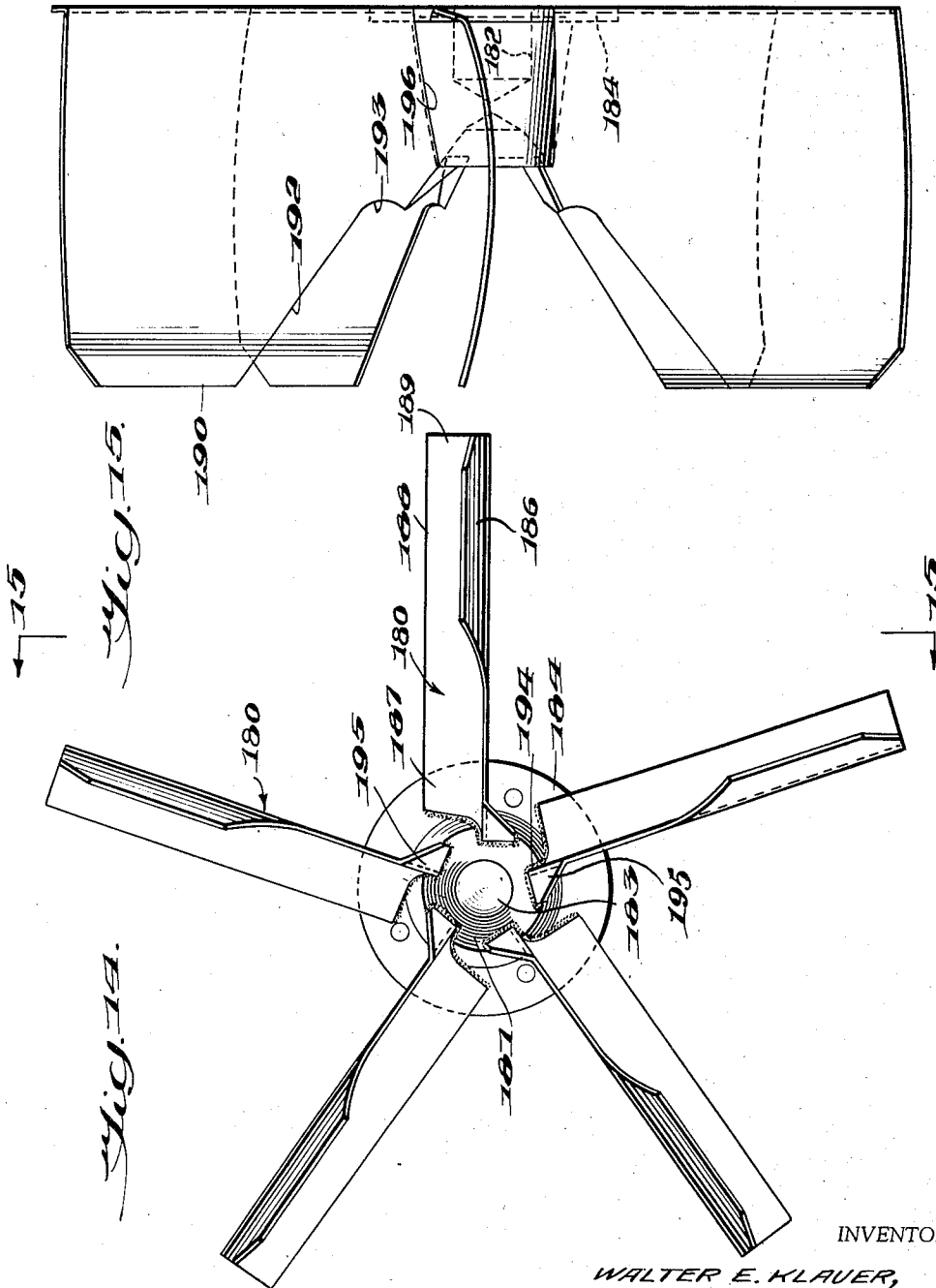
W. E. KLAUER

2,777,217

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9 Sheets-Sheet 2



INVENTOR

WALTER E. KLAUER,

BY

Robert B. Larson
ATTORNEY

Jan. 15, 1957

W. E. KLAUER

2,777,217

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9 Sheets-Sheet 3

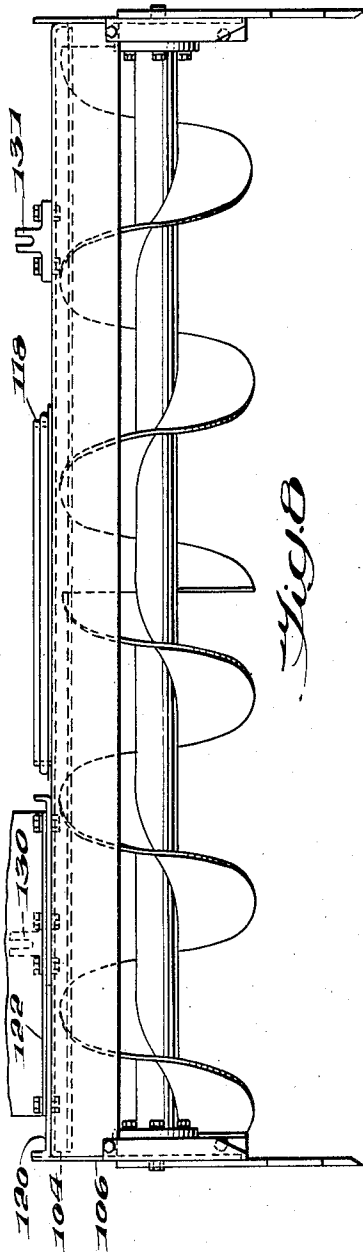


Fig. 8

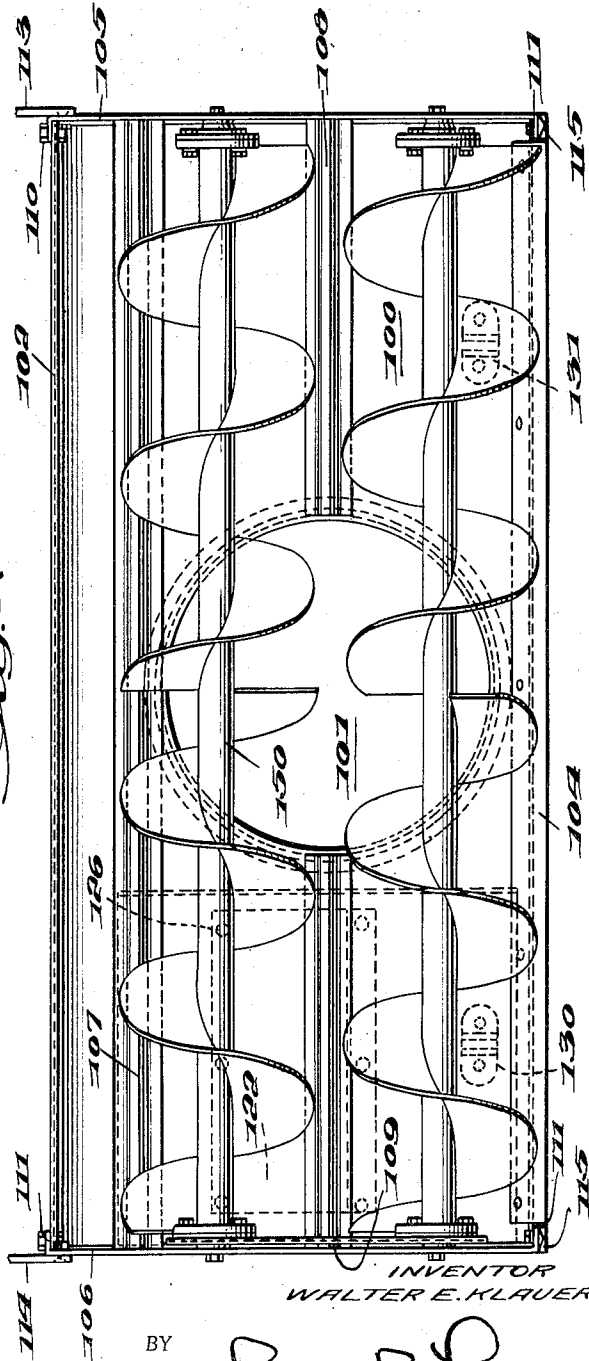


Fig. 9

INVENTOR
WALTER E. KLAUER,

BY

Robert B. Larson
ATTORNEY

Jan. 15, 1957

W. E. KLAUER

2,777,217

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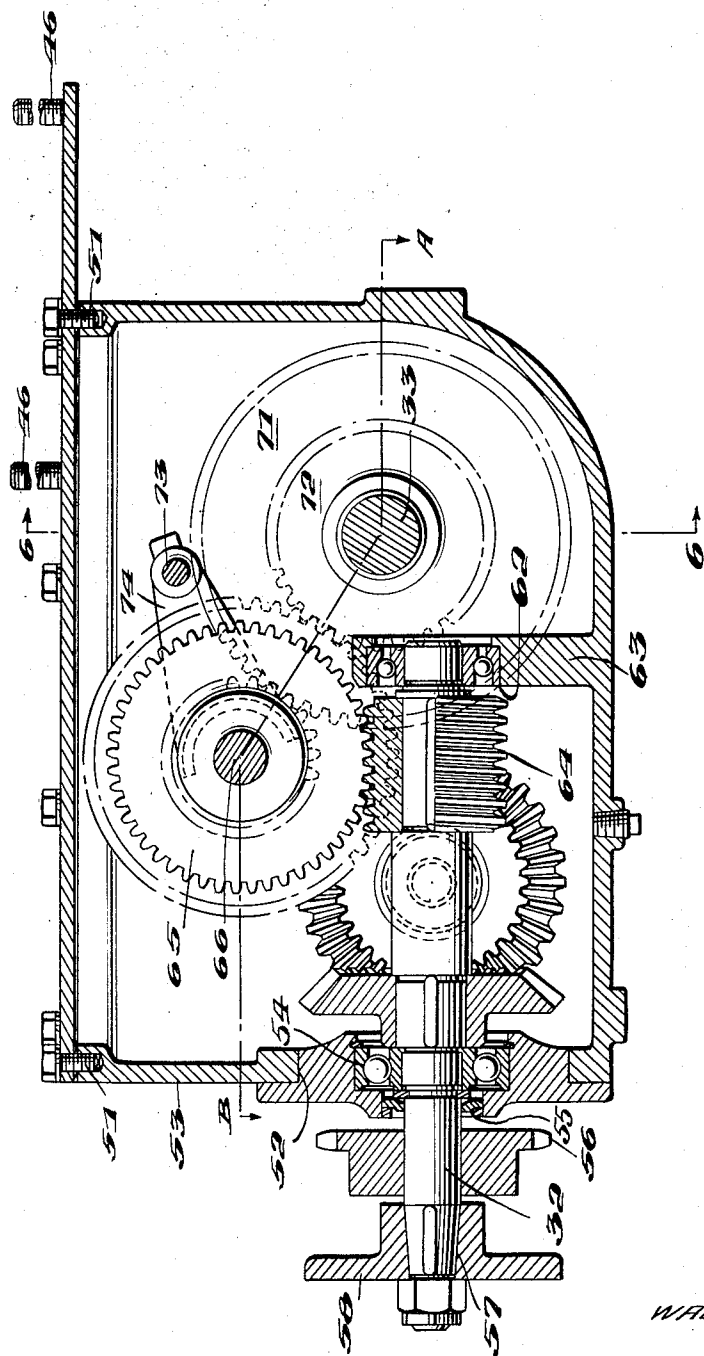


Fig. 4.

INVENTOR

WALTER E. KLAUER,

BY

Robert B. Larson

ATTORNEY

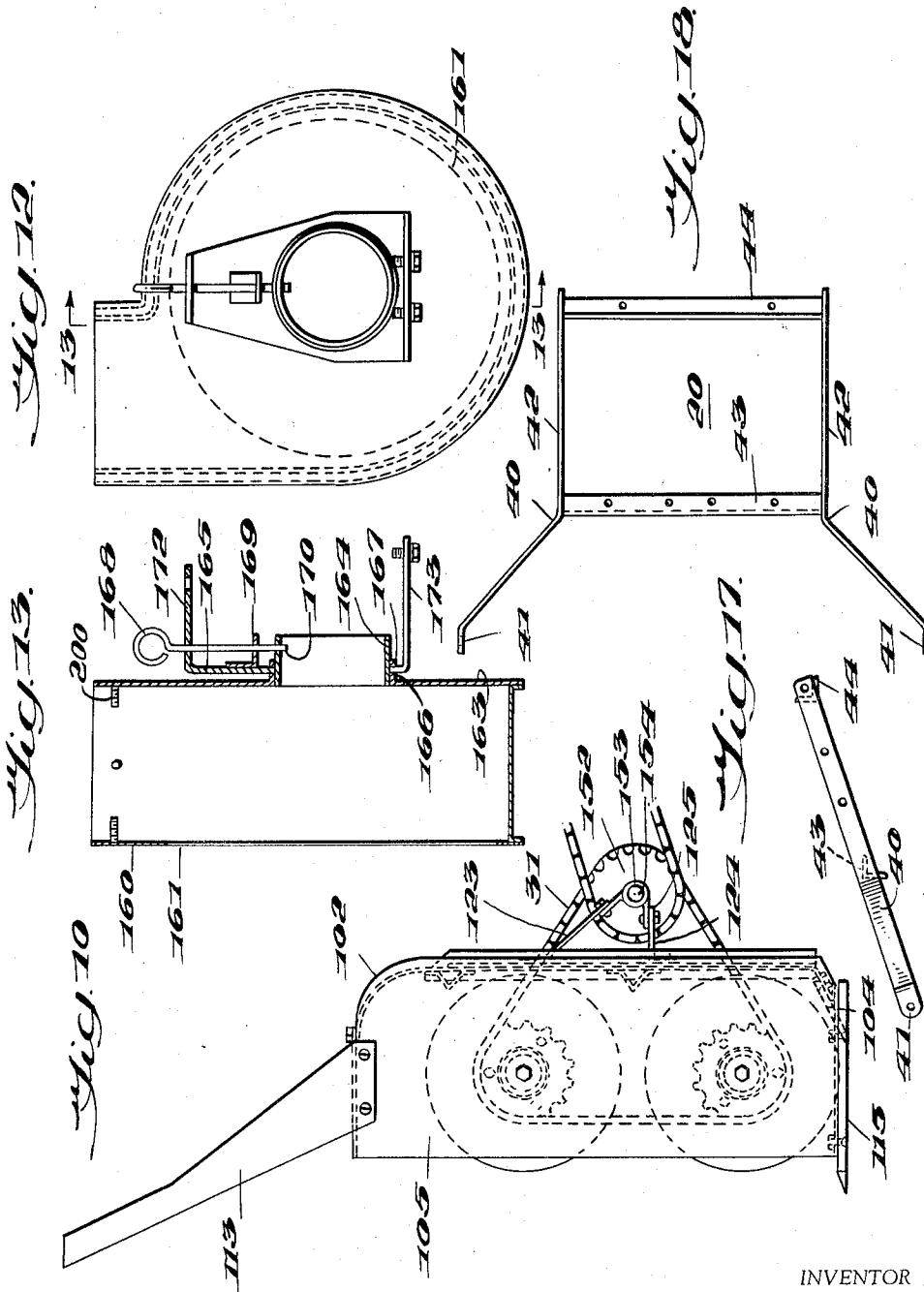
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W. E. KLAUER
SNOW REMOVING APPARATUS

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9 Sheets-Sheet 5



INVENTOR
WALTER E. KLAUER,

BY

Robert B. Kauer
ATTORNEY

Jan. 15, 1957

W. E. KLAUER

2,777,217

SNOW REMOVING APPARATUS

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9 Sheets-Sheet 6

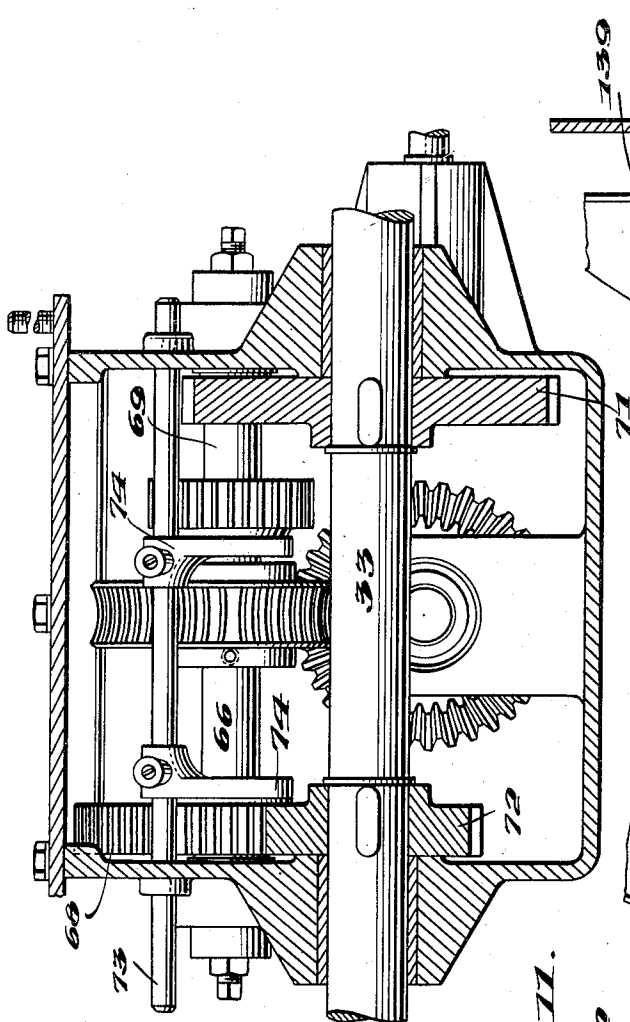
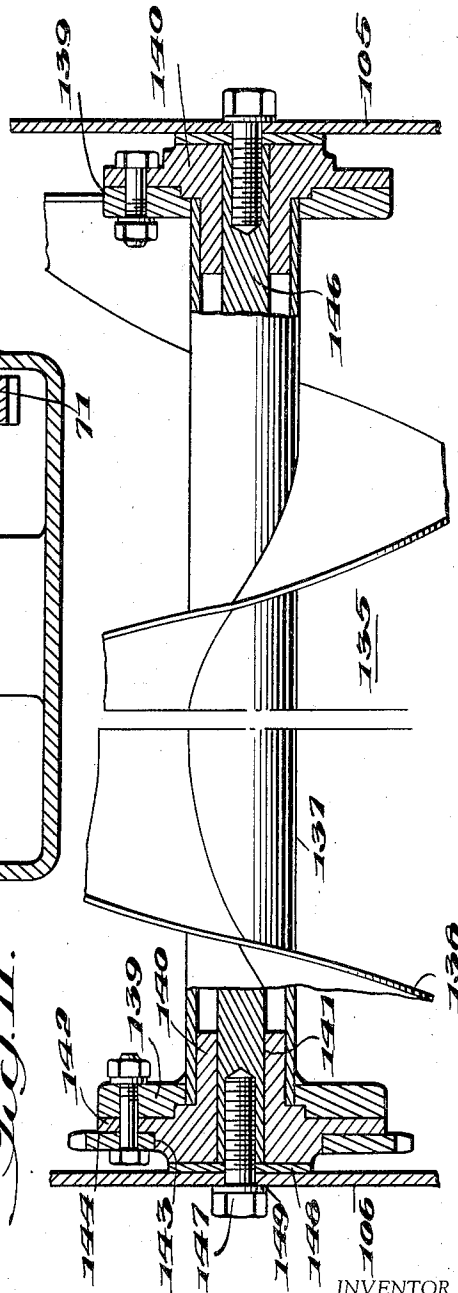


Fig. 6.

Fig. 11.



INVENTOR

WALTER E. KLAUER,

BY

Robert B. Claren
ATTORNEY

Jan. 15, 1957

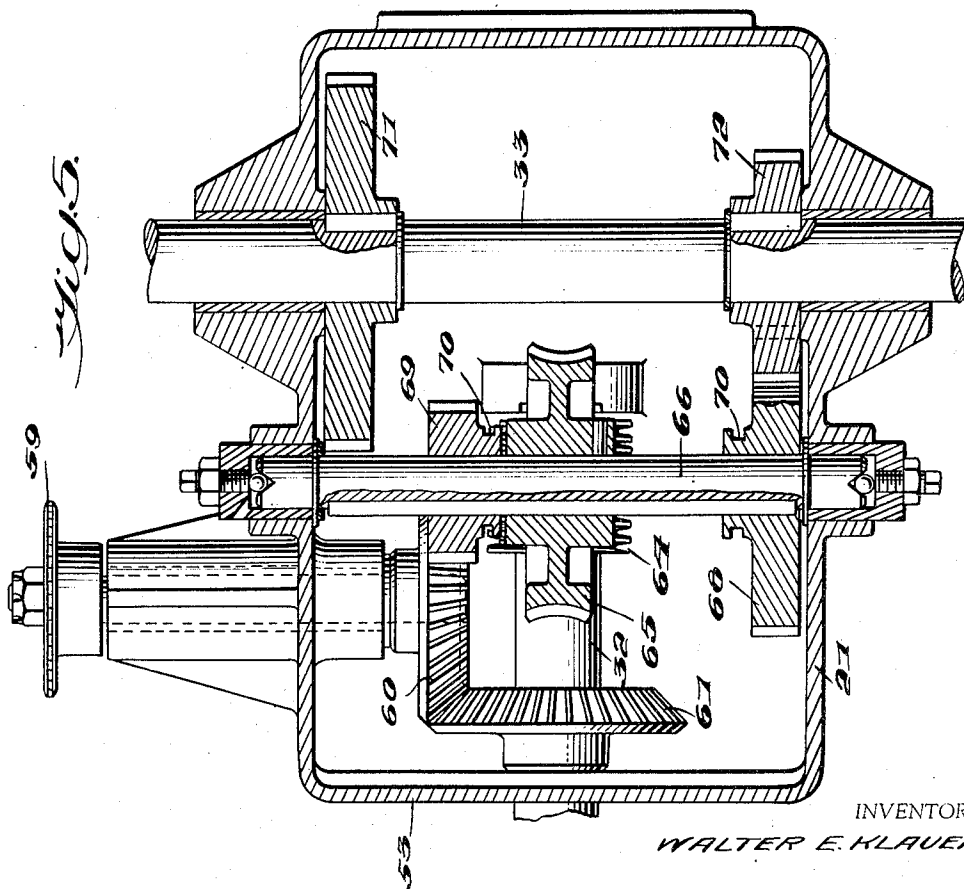
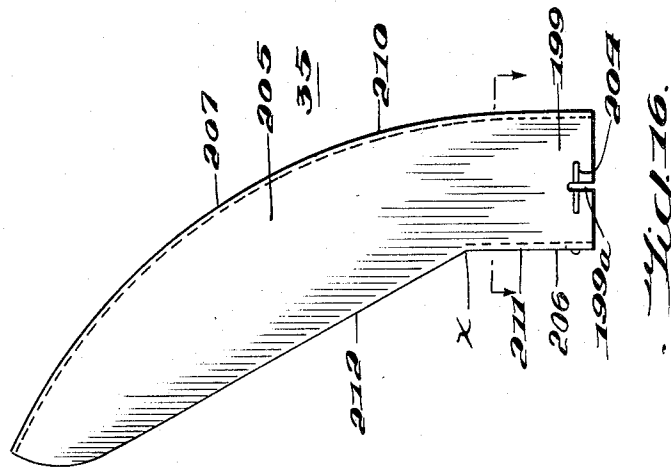
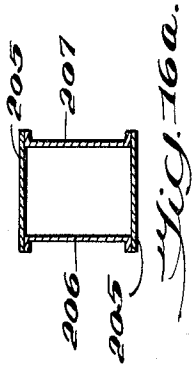
W. E. KLAUER

2,777,217

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9 Sheets-Sheet 7



INVENTOR
WALTER E. KLAUER,

BY

Robert B. Pearson
ATTORNEY

Jan. 15, 1957

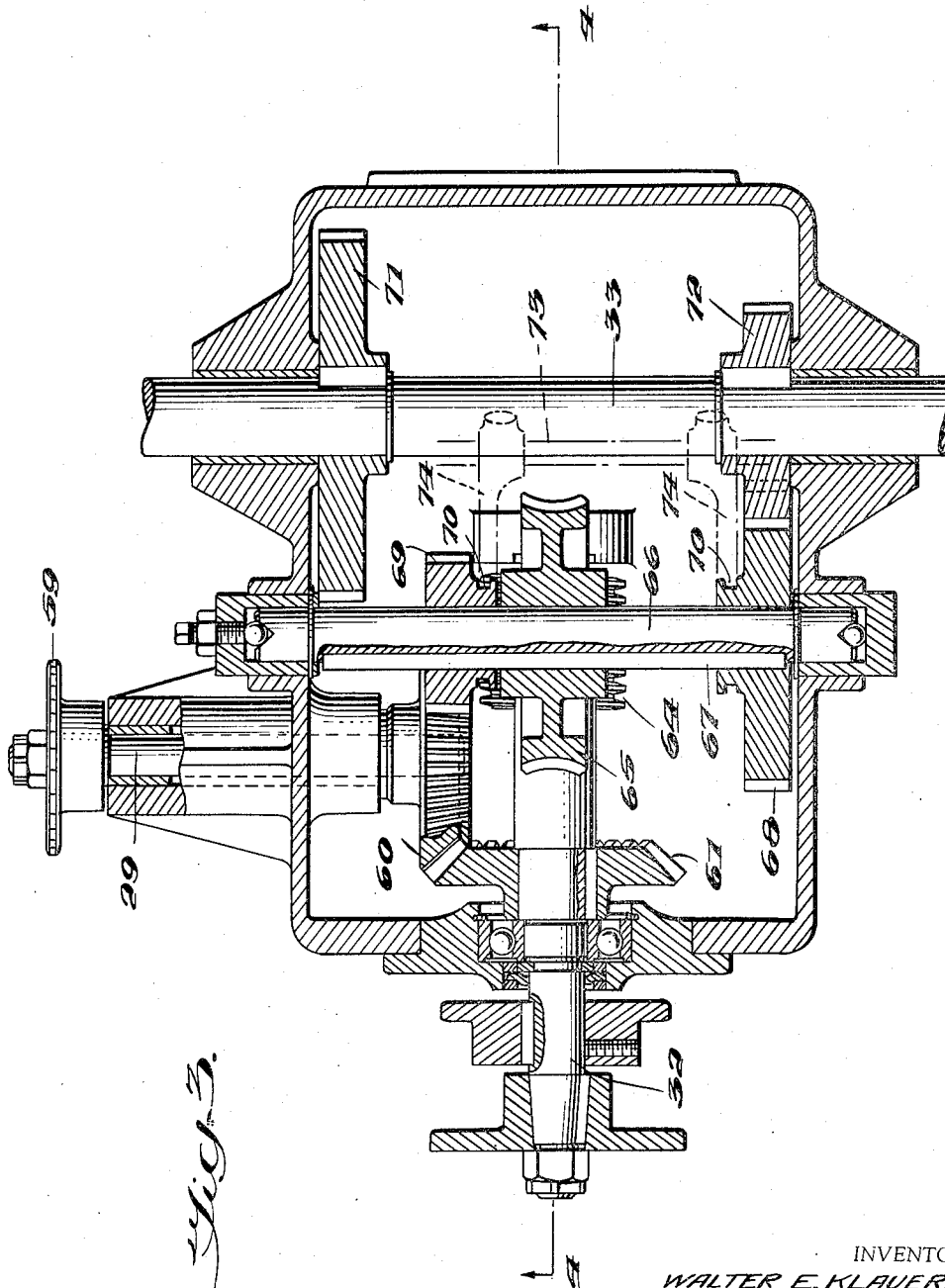
W. E. KLAUER

2,777,217

SNOW REMOVING APPARATUS

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9 Sheets-Sheet 8



INVENTOR
WALTER E. KLAUER,

BY

Robert B. Larson
ATTORNEY

Jan. 15, 1957

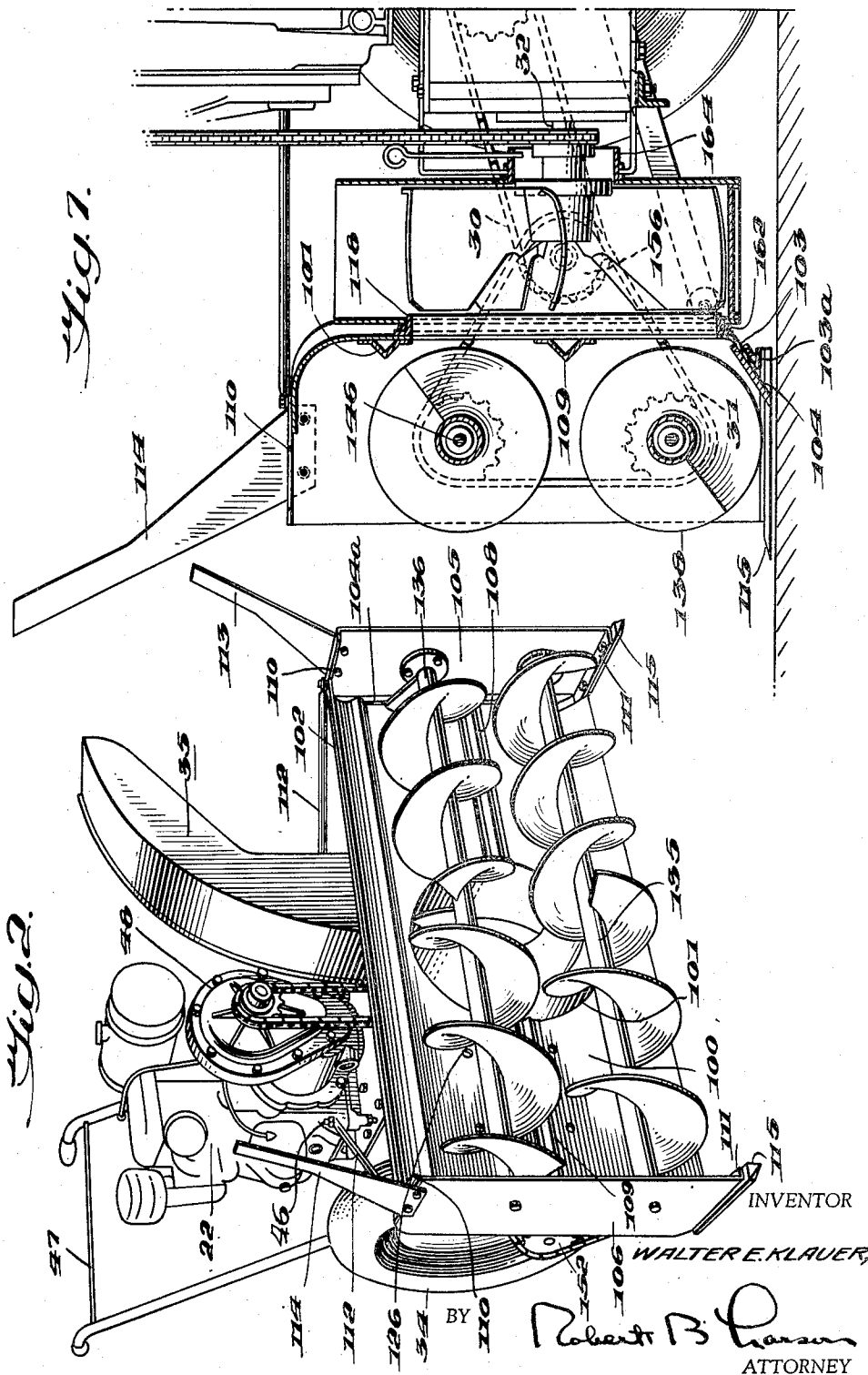
W. E. KLAUER

2,777,217

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2,777,217

SNOW REMOVING APPARATUS

Walter E. Klauer, Dubuque, Iowa

Application January 5, 1951, Serial No. 204,531

4 Claims. (Cl. 37—43)

This invention relates to snow removing apparatus. More particularly, it relates to such snow removing apparatus as is especially suitable for removing snow from sidewalks, driveways, gasoline service stations, and other relatively small areas.

Snow removing apparatus in accordance with the invention is provided with motor powered means for cutting into and gathering the snow as the apparatus is self propelled in a forward direction, and for feeding the snow to rapidly revolving blades which throw the snow upwardly through a discharge chute which directs the snow to the side or to any desired location. Such apparatus is powered by a motor which drives the cutting means, the blades and also the two wheels which support the apparatus and actuate it in a forward direction. The apparatus preferably is provided with rearwardly extending handles, akin to plow handles, and which are grasped by the operator to guide the apparatus in its travel as the operator walks along behind. It is a general object of the invention to provide such an apparatus.

It is a further object of the invention to provide such an apparatus which, while rugged enough to handle heavy as well as light snow, is nevertheless so well balanced as to enable the operator to guide, direct, and control it without the expenditure of great manual effort.

Basically, the apparatus is comprised of the following major elements: A gear box which supports a motor connected to drive the gearing in the box, the gear box having a driven axle extending therethrough, and on the opposite ends of which a pair of rubber tired wheels are mounted; a frame in which the gear box is cradled, the frame having rearwardly extending handles adapted to be grasped by the operator to enable him to direct and control the apparatus; a blower casing disposed in front of the gear box and provided with blades which are rotated from the gear box; and a snow gathering casing in front of the blower casing and supported by said frame. The snow gathering casing is provided with a number of auger-like elements which, when rotated, break up the snow and direct it through a rear opening in the casing to the blower casing so that the blades therein can throw the snow upwardly through an opening in the blower casing and outwardly through a discharge chute. The size, disposition and arrangement of these elements is such as to effect that balance necessary for easy handling.

The snow gathering casing is generally in the shape of a rectangular box open at the front, bottom and top. Within are at least two sets of augers mounted on horizontal, transversely extending, parallel axes. These are rotated by a chain drive located on the inside of the side walls of the casing. The sprockets engaged by the chain are disposed in a vertical plane, one above the other, and actuation of the chain produces a cutting action on the snow as the apparatus advances. The outer side walls of the casing are smooth, which together with the cutting action of the chain or chains, and the cutting action of the augers, greatly facilitates actuation of the apparatus

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by reducing the resistance offered by the snow in the path of the apparatus.

The invention has for another object the provision of means whereby the angle of incidence of the snow gathering casing can be varied from the vertical. When the snow to be removed is heavy it is best to adjust the casing so that its upper portion slopes slightly forwardly. This causes the apparatus to "bite" into the snow more. When light snow is to be removed, adjusting the casing to tilt it back slightly is helpful. This causes the casing to ride "on its heels" and permits the apparatus to be operated at a faster rate of speed.

It is another object of the invention to provide such snow removing apparatus with a discharge spout of special curvature and cross-sectional shape in such manner as to prevent wet snow from packing and clogging the same. The discharge chute is also mounted so as to be adjusted to direct the snow forwardly just to one side of the path to be cleared, or sidewise to either side of the apparatus.

A still further object of the invention resides in the provision of a novel and improved fan blade arrangement in which the specially shaped blades are effectively secured to a conical hub carried and driven by a shaft extending forwardly from the gear box.

Another and important object of the invention resides in the construction and arrangement of the gear box and the manner in which the driving and driven shafts and gears therein are supported to effectively stand the strains and stresses placed thereon, while at the same time provision is made for driving from the one gear box, or shaft extending therefrom, the augers, the fan blades, and the rubber tired wheels through which the apparatus is propelled.

The invention contemplates the necessity for removal of the various parts for adjustment or possible repair or replacement, and an object of considerable merit resides in the provision of the various means for mounting and supporting the parts so as to facilitate this. Thus, in accordance with the invention, it is possible to remove the snow gathering casing simply without disturbing the rest of the apparatus. The fan casing may then be removed, as may be the blower blades. The motor is easily removed from the gear box which supports it and the gear box itself can then be lifted from the frame in which it is cradled.

These and other objects of the invention will become more apparent from the following description and claims when read in conjunction with the accompanying drawings in which:

Fig. 1 is a side elevational view of snow removing apparatus constructed in accordance with the invention;

Fig. 2 is a three-quarters front elevational view of the apparatus;

Fig. 3 is a cross-sectional view taken near the upper edge of the gear box, looking downwardly, and with parts shown in section;

Fig. 4 is a longitudinal sectional view taken on line 4—4 of Fig. 3, with some of the parts shown in elevation;

Fig. 5 is a longitudinal sectional view taken on line B—A of Fig. 4;

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 4, with some parts in elevation;

Fig. 7 is a sectional view taken on a longitudinal line lying just to the left of the center of the plow, and showing the front portion of the apparatus;

Fig. 8 is a top plan view of the snow gathering device;

Fig. 9 is a front elevational view of the snow gathering device;

Fig. 10 is a left hand side elevational view of the snow gathering device;

Fig. 11 is a detail front elevational view, partly in section of one of the finned, snow moving elements of the snow gathering arrangement;

Fig. 12 is a rear elevational view of the blower casing;

Fig. 13 is a cross-sectional view taken on line 13—13 of Fig. 12;

Fig. 14 is a front elevational view of the blower;

Fig. 15 is a vertical sectional view taken on line 15—15 of Fig. 14;

Fig. 16 is an elevational view of the snow directing chute looking transversely of the direction of throw;

Fig. 17 is a side elevational view of the main frame, and

Fig. 18 is a top plan view of the main frame.

Referring to Fig. 1, the snow removing apparatus consists of a number of readily assembled parts, which include a main frame 20 (Figs. 17 and 18) which slopes downwardly from rear to front and above which is positioned a gear box 21. Above the gear box is an engine 22. A handle bar arrangement 23 is attached to the main frame 20 which includes a forwardly extending pair of arms 24 which support a snow gathering device 25. Located between the snow gathering device 25 and the gear box 21 is a blower (Figs. 14 and 15) having a housing 26 which communicates with a central opening 101 in the housing of the snow gathering device. The blower housing is mounted on the forward end of the main frame by an arrangement (Figs. 12 and 13) which permits rotatable adjustment of the blower housing 26 about a substantially horizontal axis.

The engine 22 is mounted on a horizontal plate 27 which is the cover plate for the gear box. Engine 22 drives a gear arrangement within the gear box by chain 28 to provide constant rotation of spirally finned snow gathering elements 135 and constant rotation of the blower. The snow gathering elements 135 are driven by means of a shaft 29 which extends from the right side of the gear box and drives a chain 30 which transmits rotation to a short shaft 153 adjustably mounted on the rear face of the housing of the snow gathering device. This short shaft 153 in turn drives a chain 31 which passes through openings in the rear face of the housing of the snow gathering device and passes about sprockets 144 mounted on each of the spiral gathering elements.

The blower is driven by a shaft 32 which extends forwardly from the gear box, and which comprises the main shaft which receives the drive from the engine and transmits it to the interior of the gear box. Through a suitable gearing and gear shifting arrangement under the control of the operator, the drive is transmitted to a transversely extending axle 33 which extends out of both sides of the gear box in the rear portion thereof, and upon which axle are mounted a pair of wheels 34 which provide forward motion for the apparatus. The gear shifting arrangement provides two forward speeds and a neutral position during which the wheel driving arrangement is disengaged.

The two wheels are mounted on the ends of their shaft by means of a one-way clutch arrangement.

The blower housing 26 has a square opening in its periphery through which snow is directed to a deflector or discharge chute 35 having a square cross-section at its lower end, and having a curved configuration for directing snow at an angle to its initial direction of movement into the deflector. Because of the square configuration of the discharge chute and the opening to which it connects, the chute may be positioned in any of four positions so that the snow is directed as desired. Ordinarily, the deflector would be positioned so as to direct the snow either directly to the left or to the right of the machine, or to the front and slightly to the right.

The frame

The frame of the machine comprises a pair of side members 40 having divergent forward portions with par-

allel, forwardly extending tips 41. Side members 40 have parallel rear portions 42 to which are attached spaced front and rear angle irons 43 and 44 which extend transversely of the plow. The side members 40 extend generally in a downward direction from rear to front. Spaced inwardly from the ends of the transversely extending angle irons, and extending vertically upwardly, are four upright frame members 45 which are rods or tubes having their upper ends lying in a single plane and attached at their upper ends to flat plate 27. This attachment to the flat plate 27 is conveniently effected by means of bolts extending downwardly through holes in the plate into threaded openings in the upper end of the upright frame members. This upper plate 27 serves as a cover for the gear box 21 and as a support for engine 22 which is mounted on the plate by means of four upwardly extending bolts 46 located in the rear portion of the plate.

A pair of spaced handlebars 23 are attached to the rear portions of the side frame members 40 so as to form continuations thereof, and these handle bars may conveniently be braced by a transverse element 47 located near the handle ends.

The engine

The engine 22 is of any conveniently available type, preferably operated by internal combustion, and having on the forward end thereof a gear arrangement 48 for decreasing the rotary speed and increasing the power. This gear arrangement has a forwardly extending shaft 49 carrying a sprocket 50 over which passes main drive chain 28 which transmits the drive to the gearing in gear box 21. Sprocket 50 is fastened to shaft 49 by a readily replaceable shear pin 50a which prevents abnormal loads from damaging any of the parts, since the pin 50a will shear before any parts are damaged.

The gear box

The gear box 21 is preferably of cast metal, closed on all sides except the top, where the plate 27 upon which the engine 22 is mounted forms a cover plate for the gear box. This plate is attached to the gear box by suitable bolts 51.

The gear box has a centrally located opening 52 of substantial size in the lower portion of its forward wall 53, wherein is mounted a suitable bearing 54, forward of which is a sealing arrangement 55 through which passes main drive shaft 32. This drive shaft carries on its forward end, immediately adjacent the forward wall 53 of the gear casing, a sprocket 56 which is engaged by the chain 28 driven from the engine, and it is by this means that the chain of gears in the gear box is driven. Sprocket 56 is fixed to the main shaft by the key way and by a set screw.

The extreme forward end of the main shaft is threaded, and between this threaded portion and the position of the sprocket 56 there is a tapered shaft portion 57 which receives a hub 58 to which the blower is attached. This hub is held in place by means of a nut and suitable nut locking means carried by the threaded end portion of the shaft.

The gear casing has an opening in the lower front portion of the right side wall through which extends a shaft 29 for transmitting drive to the snow gathering arrangement. The outer end of this shaft carries a sprocket 59 while the inner end of this shaft carries a bevel gear 60 positioned to mesh with a bevel gear 61 carried by the main drive shaft immediately adjacent the inner surface of the forward wall 53 of the gear box. It will be clear that the rotation of the main drive shaft thus rotates the two bevel gears, shaft 29 and sprocket 59. The only axial load placed on shaft 32 by the bevel gears is in a forward direction.

At its rear end, the main drive shaft is supported in a bearing arrangement 62 mounted in an upwardly extend-

ing wall portion 63, and immediately forward of this bearing support for the shaft, the shaft carries a helical or worm gear 64 which is keyed to the shaft and held in place by any convenient means such as snap rings. This helical or worm gear meshes with a fixed gear 65 carried by and rotatable with a transversely extending central shaft 66 positioned above shaft 32 and journaled at its ends in the side walls of the casing.

It will be noted that the only axial stress on shaft 32 is in a forward direction, so that wall 63 and its bearings 62 need carry no axial load.

The shaft 66 is provided with key means 67 extending most of its length, and a pair of gears 68, 69 of different diameter are slidably mounted on this shaft and key so as to rotate with the shaft. These two gears 68, 69 are located one on each side of the fixed gear 65 and they each have annular grooves 70 for engagement by a gear shifting arrangement.

Located rearwardly of and below the shaft 66 carrying the sliding gears is axle 33 which extends completely through the gear box and out of each side wall thereof in the lower rear portions of these side walls. This shaft carries a large fixed gear 71 mounted near one side wall of the gear casing and a smaller gear 72 keyed thereto near the other side wall of the gear casing. The large gear 71 is on the same side as the small gear 69 and carried by the central shaft 66, and the small gear 72 carried by the axle is on the same side as the large gear 68 carried by the central shaft. The ends of the main axle carry wheels 34 by means of one way clutch arrangements which cause the wheels to be driven when the axle is rotated, but which permit the apparatus to be moved backwardly without transmitting rotation from the wheels to the axle. These one way clutches comprise pieces carried respectively by the wheels and the axle and permit ready removal of the wheels. They also give a differential action.

A gear shifting arrangement is provided in the upper portion of the box generally above the main axle, and this arrangement comprises a shaft 73 which extends through both side walls of the gear box and carries a pair of forked gear engaging elements 74, one of which engages the angular groove 70 in the large moveable gear 68, while the other forked element engages the angular groove 70 in the smaller gear 69. By shifting this shaft transversely of the box by means of a gear shifting lever 75 extending to the rear of the engine, the large and small gears 68 and 69 may be shifted transversely along the central shaft 66 so as to position the large gear 68 in meshing engagement with the smaller gear 72 carried by the main axle, the smaller gear 69 carried by the central shaft then being free of engagement with any other gears. When shifted to the opposite extreme of its movement, the gear shifting shaft 73 causes the smaller gear 69 carried by the central shaft to engage the larger gear 71 carried by the main axle, the larger gear 68 carried by the central shaft then being disengaged from the smaller gear 72 carried by the main axle. In an intermediate position, neither of the gears 68, 69 carried by the central shaft is in engagement with the gears 71, 72 carried by the main axle, this comprising a neutral position in which the main axle is not driven, despite the fact that the engine, main shaft 32, shaft 29, and shaft 66 continue their rotation.

The snow gathering arrangement

The snow gathering arrangement includes a framework, or open housing, comprising a rear plate 100 having a large, circular, central opening 101. The upper edge portion of the plate 100 is curved forwardly at 102, while the lower edge portion of the plate is bent forwardly at an angle at 103 and then horizontally rearwardly at 103a. The forwardly bent portion 103 carries the transversely extending shoe 104 which is bolted thereto, preferably by a slotted arrangement which permits downward

adjustment of the shoe 104 as its lower edge becomes worn.

At each end of the plate 100 there is a forwardly extending flange 104a to which is attached by welding or other suitable means the two side plates 105 and 106 which lie outside of flanges 104a and extend slightly to the rear of plate 100. A bent piece of sheet metal 107 of V cross section is welded to the forward surface of plate 100 near its upper edge for reinforcing purposes and similar reinforcing pieces 108 and 109 are welded to the front face of plate 100 on either side of the central opening 101 therein. The two end pieces 105 and 106 are bent inwardly in a horizontal direction at their upper and lower edges 110 and 111 respectively, and the forward edges of upper inwardly bent portions 110 are cut back at an angle to the transverse direction. These upper bent portions 110 provide a convenient means for attachment to the corners of the forwardly bent portion 102 of the back plate by bolts, and the location at which these two pieces overlap on each side of the machine is advantageously used for an attachment of an upper brace 112 at each side of the machine by these bolts. These upper braces are attached at their rear ends to the forward pair of bolts 46 (Fig. 2) by which the engine is mounted on the plate.

The upper portions of the side members 105 and 106 carry thin, upwardly extending cutting elements 113 and 114 which are bolted thereto, and which extend forwardly at an angle to the vertical, the upper ends of these members being located forwardly of the lower ends thereof.

Shoes 115 are bolted to the underside of inwardly bent portions 111 at the lower edges of the side members 105 and 106. Countersunk bolts are conveniently used for attaching these shoes, the nuts for these bolts being located on the upper side of the portions 111, thus providing ready replacement of the shoes 115.

An annular piece 118 is welded to the rear surface of plate 100 so as to surround the opening 101 and to provide a rearwardly extending flange, which forms a continuation of the opening 101.

On the rear surface of the back plate 100, and on the right side, looking from the rear, a reinforcing plate 120 is welded to the plate 100. Plate 120 has its vertically extending edges bent rearwardly at a right angle to form flanges, the outermost of which is welded to the rear edge of side plate 105. Mounted on the rear surface of the reinforcing plate 120 are rearwardly extending brackets as shown at 123 and 124. Brackets 123 and 124 converge and provide a mounting for attachment of a shaft support 125 by bolts passing through slots in the brackets, thus permitting variable adjustment of the shaft support 125 toward and away from the back plate 100 of the snow gathering device. A plurality of bolts 126 pass from the front surface of the back plate 100 through the brackets 123 and 124 and through the mounting plate 122 to hold the brackets in place.

A pair of attaching lugs 130 and 131 are attached to the rear surface of the reinforcing plate 120 and to the rear surface of the back plate 100, respectively, by means of bolts. These lugs each consist of a pair of spaced, rearwardly extending arms having a bolt hole passing therethrough so as to provide means of attaching the forward ends 41 of the downwardly sloping frame members 40.

The gathering of the snow within the framework or the housing provided by back plate 100 and side plate 105 and 106, is carried out by a pair of spirally finned elements 135 and 136 mounted vertically one above the other. These elements each consist of a tubular shaft 137 carrying two spiral fins 138 of opposite hand, arranged so as to feed snow inwardly toward the opening 101 when rotated. At the center line of the machine where the two fins on each of the tubular shafts 138 meet, it will be noted from the drawings that the end edges of the two fins of opposite hand extend along a

single diameter passing through the tubular elements to 137, and are disposed opposite each other.

On each end of the tubular shafts 137 there is welded a collar 139 having spaced bolt holes therein. The ends of the tubular shafts 137 are substantially closed by plugs 140 which fit snugly within the ends of the elements 137 and have concentric bores 141. The plugs 140 have also peripheral flanges 142 which are provided with bolt holes for ready attachment to the collars 139. The plugs 140 are all identical and are each provided with an exterior cut out portion 143 which provides a convenient mounting for sprocket wheels 144 on the right ends of the tubular shafts 137. These sprockets 144 are bolted to the flanges 142 of plugs 140, and also to collars 139 on the right ends of the shafts 137.

A mounting or axle rod 146 passes axially through each tubular shaft 137 and through the bores 141 in plugs 140. The ends of the rods 146 are threaded so as to receive bolts 147 which pass through suitably located holes in end plates 105 and 106 to provide support for the rods in these end plates. Suitable washers 148 and 149 are provided between the plugs 140 and the end plates and between the end plates and the heads of bolts 147.

Lubrication over a long period on one filling is provided by means of fittings 150 located at the center of each tubular shaft 137 so as to provide means for filling the interiors of these tubular shafts with lubricant.

It will be noted that the right ends of the tubular shafts 137 are provided with sprockets 144, and it will also be seen from the drawings that a chain 31 disposed substantially in a triangular course passes about both of these sprockets and rearwardly through suitably disposed openings in back plate 100 and supporting plate 120 so as to pass about a driving sprocket 152 positioned to the rear of the extreme right side of the back plate 100.

Driving sprocket 152 is fixed to a suitable shaft 153 which is rotatable in a journal 154 attached to brackets 123 and 124 by means of bolts. As explained previously, brackets 123 and 124 have slots through which the bolts pass and this permits adjustment of the shaft 153 and sprocket 152 to provide the correct tension on the drive chain. Drive sprocket 152 is located on the outer end of shaft 153 and another sprocket 156 (Fig. 7) is mounted on the inner end of this shaft in line with the sprocket 59 carried by shaft 29 which extends out of the right side of the gear box. The drive chain 30, which passes about these last two sprockets, transmits drive from the shaft 29 to the sprocket 156 which drives shaft 154 and outer sprocket wheel 152, which in turn drives chain 31 which passes about the sprockets 144 carried on the right ends of hollow shafts 137.

It will be noted that the forwardmost portion of the course of drive chain 31 extends vertically, and it has been found that this moving chain exerts a cutting motion which assists in cutting into the snow.

The blower or impeller casing

A generally circular casing 26 is mounted to the rear of the opening 101 in the rear plate of the snow gathering device. When viewed from the rear, the continuity of the circular exterior of the casing of the blower is broken by an upwardly extending portion 160 which is square in horizontal section. The casing has a large circular opening 161 in its front wall which is dimensioned to fit snugly about the flange 118 which extends rearwardly from the corresponding opening 101 in the snow gathering device. A spacing ring 162 is ordinarily placed about the flange 118 forwardly of the blower casing.

The rear wall 163 of the blower casing has a smaller opening coaxially located with respect to the opening 161 in the forward wall, and a sleeve 164 is welded to the periphery of this smaller opening so as to extend rearwardly therefrom. Sleeve 164 extends into an opening in a vertical portion of a mounting bracket 165 which is

maintained in position on the sleeve 164 by means of a pair of rings 166 and 167 which are welded to the periphery of sleeve 164 forwardly and rearwardly of bracket 165. The engagement of bracket 165 and sleeve 164 is loose enough to permit rotation of the sleeve 164 and the blower housing about the axis of the front and rear openings in the blower housing. The orientation of the blower housing can be fixed by means of a vertically slidable pin 168 which slides in an upper, rearwardly extending arm 172 of bracket 165 and in a guide 169 mounted on its rear surface. This pin is positioned so as to enter any of several peripherally spaced openings 170 in sleeve 164.

Bracket 165 also has a lower, rearwardly extending arm 173, and in mounting the blower casing, the upper arm 172 is bolted to the upper surface of plate 27, while the lower arm 173 is bolted to the forward transverse frame member 43. When so mounted, the forward end of the main shaft 32 extends into and through sleeve 164 (Fig. 7), and drive sprocket 56 (Fig. 4) is positioned just to the rear of sleeve 164. Collar 58, which is mounted on the tapered forward end of the main shaft, is then located with its forward face lying just inside the blower casing for attachment of the blower, itself.

The blower or impeller

The blower or impeller comprises five blades 180 mounted 72° apart about a hub 181. The shaping and number of the blades is of great importance for successful operation, and the construction shown in Figs. 14 and 15 has been found to be the most successful one.

Hub 181 is tapered in outline when viewed from the side, the rear of the hub being of greater diameter than the front. A cylindrical axial bore 182 extends into the rear surface of the hub to receive the front end of main drive shaft 32 and the nut carried thereby. Another bore 183 is provided in the front wall of this hub, this bore being conical.

A flat ring 184 having the diameter of its opening smaller than the rear diameter of the hub and its outer diameter considerably greater than the rear diameter of the hub is welded to the rear surface of the hub, coaxially therewith. The ring thus forms what amounts to a transversely extending rear flange on the hub, and by means of spaced bolt holes passing from front to rear through the ring, this ring and the hub 181 are bolted to the hub 58 mounted on the forward end of main drive shaft 32.

The blades 180 are all identical and are stamped out of $\frac{1}{16}$ " sheet metal. Each blade is arcuate when viewed from the end, and the rear edge of each blade is bent in the direction of rotation to form a flange 186, the innermost portion 187 of which is positioned to lie flat along the front surface of ring 184 where the two overlap. The portion 188 of flange 186 lying outwardly of ring 184 is bent rearwardly a greater distance so as to lie substantially in the plane of the rear surface of ring 184 and to move in close proximity to the front surface of the rear wall of the blower casing. It will be noted from Fig. 15 that the exterior portion 188 of the flange is disposed at a small angle to the rear wall of the blower casing so as to pick up snow lying against this rear wall.

Except for portion 187, the rear edge of each blade lies perpendicular to the axis of the blower, and the outer or peripheral edge 189 of each blade is perpendicular to the rear edge. The outer portion 190 of the front edge of the blade is parallel to the rear edge of the blade, and the corner where edges 189 and 190 would meet is cut off to form an angular corner edge.

The inner portion 192 of the front edge of the blade extends rearwardly and inwardly at an oblique angle to the front edge 190, this angle preferably being about 128°. Edge 192 terminates at its rear and inner end in a curved portion 193 which merges into the forward edge 194 of a tab 195. This tab is substantially triangu-

lar in shape and extends in a direction opposite to the direction of flange 186. Tab 195 extends further inwardly than any other part of the blade and is oriented so as to lie along the conical surface of the bore 183 in the front wall of hub 181.

Rearwardly of tab 195 is an inner edge 196 which extends inwardly toward the axis of rotation so as to match approximately the outline of the hub. Edge 196 and the outer surface of hub 181 makes an angle of approximately 84 degrees with a plane perpendicular to the axis of rotation and lying rearwardly of the hub.

The arcuate blades are disposed on the hub so that a radius from the axis of rotation will lie along the convex side of the blade roughly midway between the front and rear edges of the blade. A chord drawn across the arcuate blade from the fold line of flange 186 to front edge 190 will lie substantially parallel to the axis of rotation.

The blades are welded as shown in Figs. 14 and 15 to ring 184, to the outer surface of hub 181 and (by tabs 195) to the surfaces of bore 183.

The chute or deflector

The chute 35 (Figs. 16 and 16a) has a square lower end made up of four sides 199 slotted centrally at 199a to receive threaded studs 200 (Figs. 12 and 13) which have heads on their inner ends and onto which are screwed wing nuts located outside each wall of the square, upwardly extending portion 160 of the fan casing. The square lower end of the chute fits within the upper end of casing extension 160, the slots 199a fit over the studs 200 with the stud heads 201 against the inner surfaces of walls 199, and the wing nuts 202 are then tightened to hold the chute in place. An outwardly extending raised bead or embossing 204 on each wall 199 assists in holding the chute against slipping upwardly.

The chute is made up principally of two identical side-pieces 205 shaped as shown in Fig. 16, a short wall piece 206, and a long, curved back wall piece 207. The longitudinal edges of wall pieces 206 and 207 are bent outwardly of the chute so as to be along the side pieces to which they are then readily attached by spot welding. The entire side of the chute above the termination of wall 206 at point X and opposite wall 207 is open.

The shape of the chute is rather critical in order to maintain a smooth and unimpeded flow of snow during operation. The rectangular cross section of the chute is important in achieving this objective, and a smooth chute interior is obtained by the joining of the walls in the manner shown in Fig. 16a, that is, with the edges of the pieces 206, 207 flanged outwardly. A similar advantage is obtained in the blower casing by a similar construction as shown in Fig. 13. This flanged construction adds greatly to the rigidity and strength of the chute as well as to economy in production. All rolled seams are eliminated.

The shape of side pieces 205 is the major factor in determining the shape of the deflector or chute. In one successful embodiment, the "back" edge 210 of each side piece is formed as an arc of a circle drawn about a radius of about 30 inches. This curve begins just above walls 199, which comprise the portion of the base of the chute extending into blower housing extension 160, and continues to the upper tip of the chute, extending through a distance of about 33½ inches and an arc of 64 degrees taken about its center of curvature. The "front" edge 211 of each side piece 205 extends upwardly perpendicularly to the lower edge of the chute up to point X, a distance of about 4¾ inches and then extends as shown at 212 in the direction of snow throw at an obtuse angle to edge portion 211. This provides a wider wall at the intermediate part of the deflector and is important in keeping snow from flying out of the deflector before it reaches the upper tip thereof. Edge portion 212 at its upper lip curves toward "rear" edge 207 in a curve.

The overall width of each side of the square base of the deflector is about 6¾ inches. The height of walls 199 is about 17½ inches, and the greatest width of each side 205 is about 8½ inches taken along a radius of the curve of back 210.

An important factor is the relation of the radius of curvature of the back of the deflector and the radius of the circular impeller housing or casing 26. In the embodiment described, the radius of the circular casing 26 is about 7½ inches and the radius of curvature of the back 210 of the deflector is about 30 inches, a ratio of one to four. This ratio is critical in obtaining proper throwing of the snow and preventing blocking of the deflector and should be maintained when different sized embodiments are made.

Another important consideration in the dimensioning of the chute is that a tangent to the curve of back 210 of the deflector at the upper tip of the deflector where the snow leaves the deflector, should lie at an angle of 28 to 30 degrees above horizontal when the lower end of the chute and the upwardly extending portion 160 of the impeller casing are disposed vertically.

In a general manner, while there has been disclosed what are practical and efficient embodiments of the invention, it should be well understood that there might be changes made in the arrangement, disposition and form of the parts, without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

I claim:

1. In a snow removing apparatus, a substantially circular blower casing mounted for rotary displacement about a horizontal axis, said blower having an inlet opening in its front face, a tangentially positioned outlet of substantially square cross section, a discharge chute having a square base, means for detachably securing said base in said outlet so as selectively to position said discharge chute to discharge snow and direct it to either side of the apparatus or forwardly thereof, the major portion of said discharge chute consisting of a pair of parallel side walls and a back wall, said side walls having curved rear edges, the intermediate portion of said side walls being wider than two end portions thereof to prevent snow from leaving the chute intermediate the ends thereof, the front of the chute opposite the back wall being open.

2. Snow removing apparatus according to claim 1, said discharge chute having a back wall curving as an arc of a circle in the direction in which the snow is thrown, the radius of the circular blower casing being substantially one-fourth the radius of the curve of the back wall.

3. Snow removing apparatus according to claim 2, the curve of said back wall extending through an arc of substantially 64 degrees.

4. In snow removing apparatus, a substantially circular blower casing mounted for rotary displacement about a horizontal axis, said blower having an inlet opening in its front face, a tangentially positioned outlet of substantially square cross section, a discharge chute having a square base, means for detachably securing said base in said outlet so as selectively to position said discharge chute to discharge snow and direct it to either side of the apparatus or forwardly thereof, the major portion of said discharge chute consisting of a pair of parallel side walls and a back wall, said side walls having curved rear edges, the front of the chute opposite the back wall being open.

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