Sept. 8, 1953

J. R. SHANNON

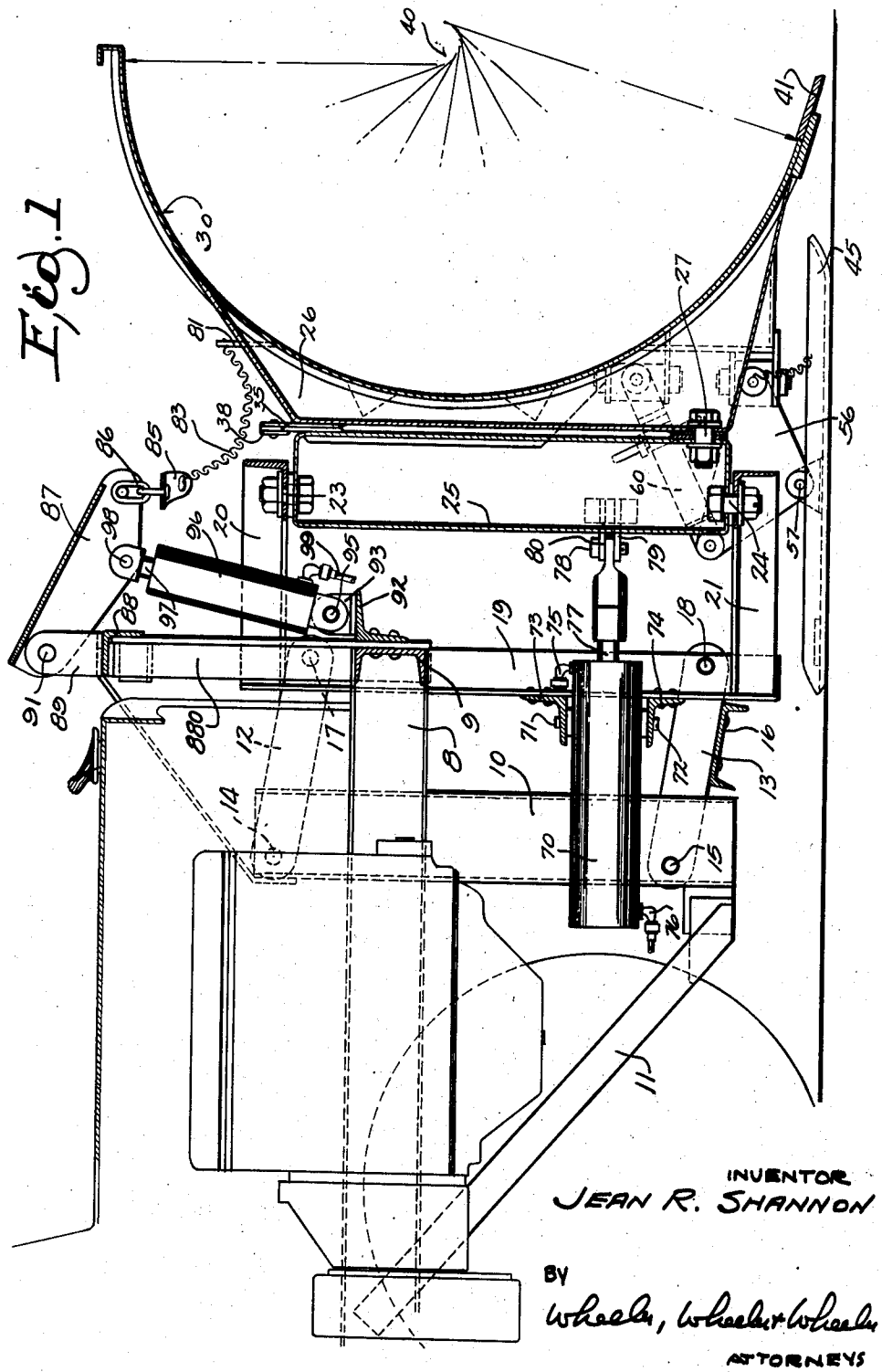
APPARATUS FOR HIGH-SPEED SNOW REMOVAL WITHOUT WINDROWING

2,651,121

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3 Sheets-Sheet 1

Fig. 1



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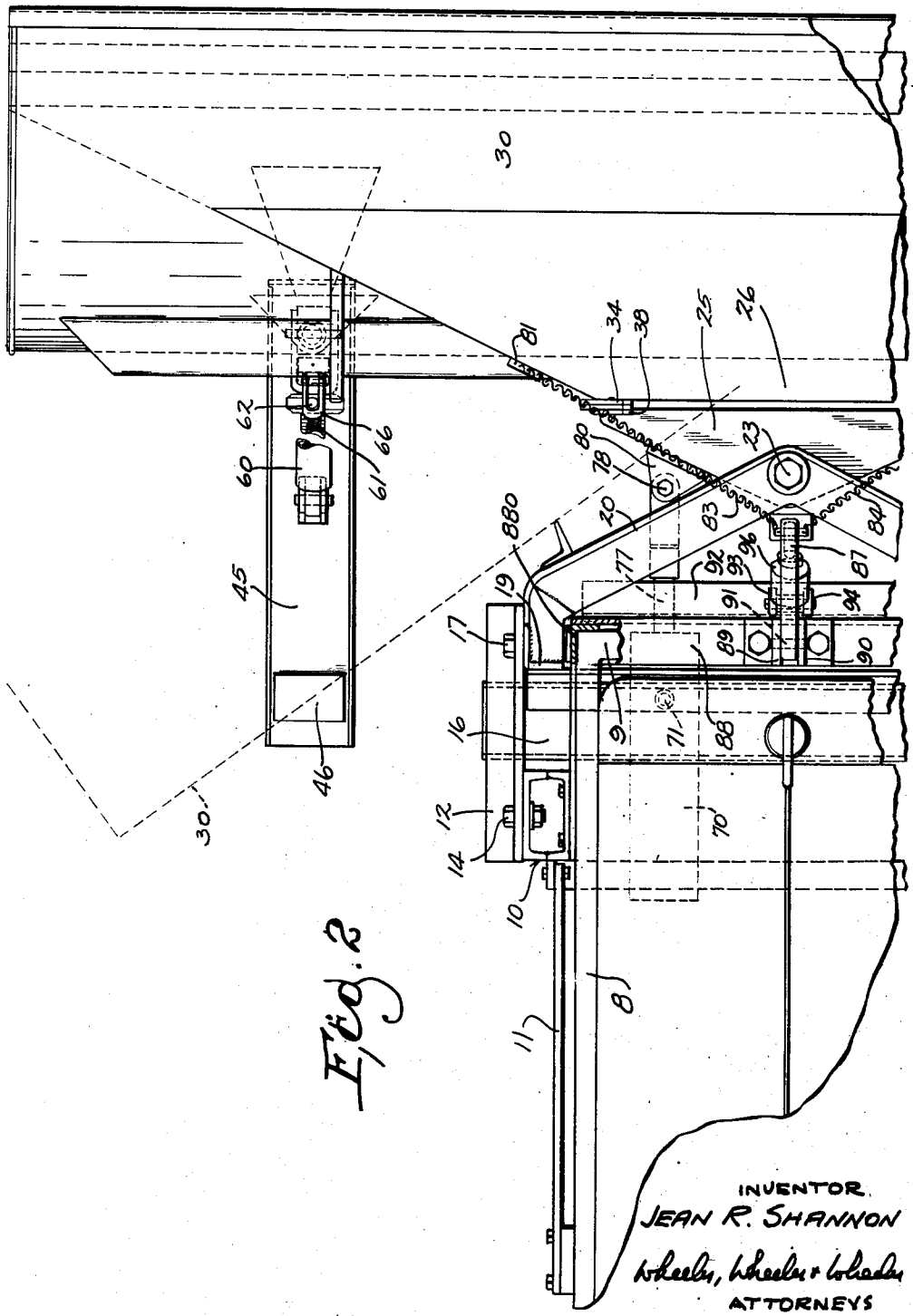


Fig. 2

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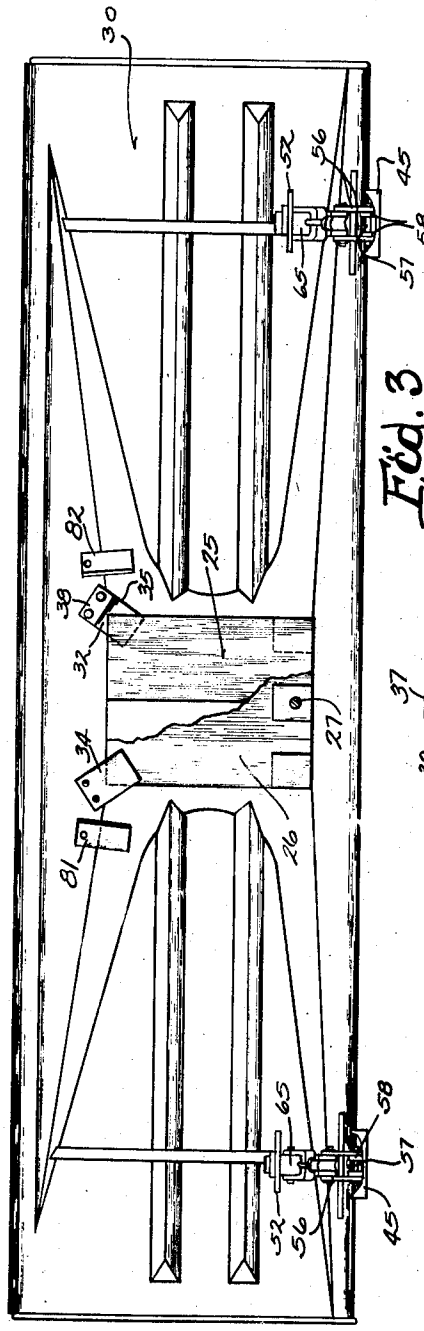


Fig. 3

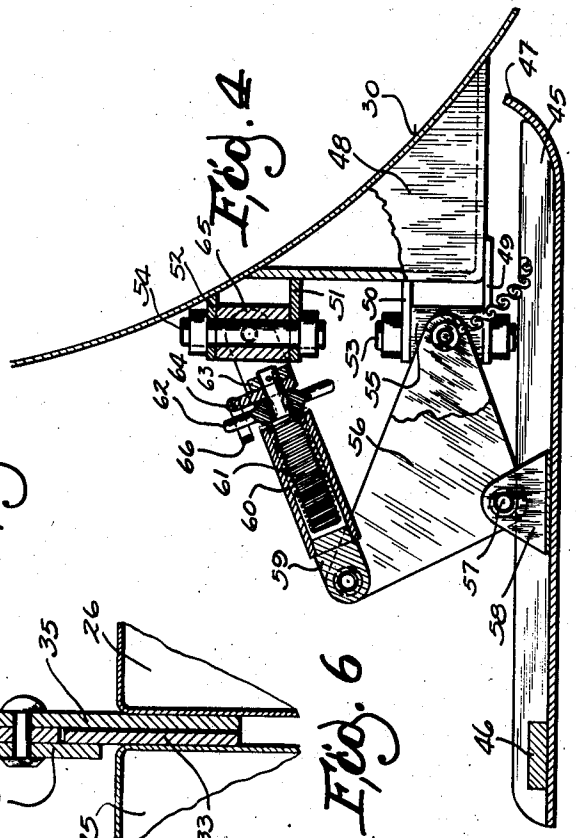


Fig. 4

Fig. 6

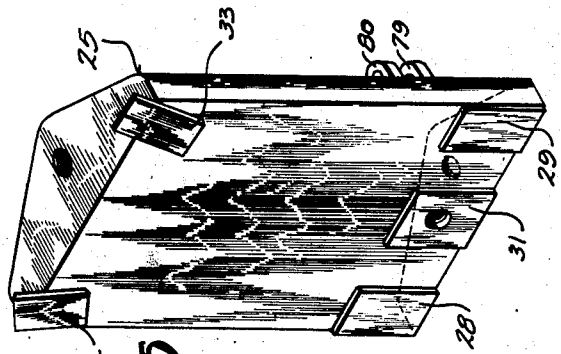


Fig. 5

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APPARATUS FOR HIGH-SPEED SNOW REMOVAL WITHOUT WINDROWING

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9 Claims. (Cl. 37—42)

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This invention relates to methods and apparatus for high speed snow removal without windrowing.

All conventional snowplows of the mouldboard type displace the snow laterally for a distance just adequate to clear the path of the plow, the displaced snow remaining in a windrow adjacent such path. It is a primary object of the present invention to provide a snowplow of the mouldboard type which will lift and broadcast the snow down wind to considerable distances from the path of the plow and in a manner which does not concentrate the displaced snow in a windrow but, on the contrary, spreads it over a wide area. The improved method and apparatus are particularly designed for clearing airports where a windrow would be a definite hazard and would constitute an obstruction in the path of the wings of planes, even though the snow were removed from the path of the wheel.

Reference has been made to the delivery of the snow down wind. In order to accomplish this result, it is necessary that the plow be readily reversible as to angle so that the down wind delivery can be maintained regardless of the direction of the propelling vehicle across the path of the wind.

Reference has also been made to the high speed broadcasting of the snow. Not only must the improved plow be of such a character that it will function efficiently at the maximum practical speed of the available vehicle, but there is more to the matter than merely moving the vehicle at high speed. The shape of the mouldboard must be designed in such a manner that at high speeds the snow will not come over the top and on to the vehicle windshield and, moreover, it is very important that the snow will move over the face of the mouldboard in a path to be delivered from the end thereof and will be constantly accelerated in velocity due to the form of the mouldboard, thereby achieving a very high velocity of delivery.

Other important objects relate to the provision of a novel supporting and adjusting arrangement for the mouldboard, the weight being normally carried during use on shoes which are "castered" or self-adjusting as to angle and which permit instant reversal of the mouldboard; the provision of an arrangement whereby the plow may be lifted from the ground or restored to operative position without varying the angle to which it is adjusted; the provision of means whereby the mouldboard may accommodate itself to irregularities in the surface traversed without in any

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manner affecting its angle of adjustment; the provision of means whereby the lifting of the mouldboard will occur vertically in any angle to which the mouldboard is adjusted; and the provision of novel and effective means for making the various adjustments in a manner which does not involve operator fatigue or does not subject the adjusting mechanism to side thrust during operation.

Other objects of the invention will be apparent from the following disclosure thereof.

In the drawings:

Fig. 1 is a view in longitudinal section through apparatus embodying this invention as it appears applied to the forward end of a vehicle.

Fig. 2 is a plan view of the apparatus shown in Fig. 1.

Fig. 3 is a view in rear elevation of a mouldboard and its supporting shoes.

Fig. 4 is an enlarged fragmentary detail view in section through the mouldboard showing one of the shoes in longitudinal section.

Fig. 5 is an enlarged detail view in front corner perspective of the adjustable thrust member which propels the mouldboard.

Fig. 6 is an enlarged detail view fragmentarily illustrating in vertical section the connection between the mouldboard and the thrust member.

The usual longitudinal frame members 8 of the vehicle are cross connected at their front ends by a channel 9. Behind this a pair of uprights 10 are connected to the frame members 8 at opposite sides of the vehicle, these being desirably also made of channels as shown in Fig. 2. The lower ends of uprights 10 are connected by braces 11 with the vehicle frame as indicated in Fig. 1. Although the drawings show only one side of the vehicle, it will be understood that the structure is duplicated at the other side thereof.

To the top and bottom of the vertical members 10, the upper and lower parallel links 12 and 13 are pivoted at 14, 15, respectively. The lower links 13 are cross connected by a channel 16 which requires them to move rigidly as a unit. At their forward ends, the upper links 12 are pivoted at 17 and the lower links 13 are pivoted at 18 to the side members 19 of a sub-frame comprising upper and lower yokes 20, 21, each of which projects forwardly from the plane of the upright side members 19, as appears both in Fig. 1 and Fig. 2. The subframe is movable upwardly and downwardly guided by the parallel links 12, 13 at opposite sides of the vehicle, which keep the sub-

frame in the same upright position in all adjustments vertically.

The yokes 20, 21 are centrally provided with fulcrum bolts 23, 24 for the thrust member 25 which is wedge-shaped as best shown in Fig. 5, its apex being rearwardly directed and its flat face being forwardly directed. The fulcrum bolts 23, 24 are axially aligned and preferably on a common vertical axis about which the thrust member 25 is oscillatable. The mouldboard 30, hereinafter to be described in more detail, is provided symmetrically of its back with a reenforcing and mounting bracket 26. Pivoted to the thrust member for oscillation about a horizontal longitudinal axis near the bottom of the thrust member is the pintle bolt 27 (Fig. 1). Near all of the corners of the thrust member 25, and also in the vicinity of a pintle bolt 27, the thrust member is provided with wear pads 28, 29, 31, 32, 33 (Figs. 5 and 6). Wear pads 32 and 33 project from the upper corners and the complementary wear pads 34, 35 on the mouldboard bracket 26 carry spacers 37 and retaining clips 38 (Fig. 6) which, engaged over the pads 32, 33 of the thrust member 25, hold the upper part of the mouldboard to the thrust member while permitting freedom of oscillation of the mouldboard in a transverse plane about the pintle bolt 27 without affecting the position of the thrust member 25.

The mouldboard is of unusual design in that its curve in vertical section is a spiral or volute curve which, in actual practice, has been made as indicated diagrammatically in Fig. 1. From the construction circle drawn in broken lines at 40 (Fig. 1), a tangent is drawn vertically for approximately 28⅝ inches to the top of the mouldboard. At successive arcs offset angularly by 20° from each other, the radius of the mouldboard is progressively increasing to 29¼ inches to 30¾ inches to 31¼ inches to 32 inches to 32¾ inches to 33⅜ inches and finally to 34 inches, the latter radius extending through the bottom of the mouldboard immediately adjacent its scraping edge 41. It will, of course, be understood that the dimensions and angles indicated merely represent the best construction currently known and do not represent a prerequisite to the use of the invention, other dimensions and volute forms being suitable for varying requirements. The particular form illustrated does give a mouldboard sufficient height, and of such shape, as to impart the desired helical spiral path to the snow acted upon for the delivery of such snow from the end of the mouldboard without any appreciable quantity thereof passing over the top.

The two ends of the mouldboard are desirably supported in flexible and vertically adjustable manner upon self-adjusting shoes 45 (Fig. 4). Each of these shoes is made of metal and has the general form of a ski. It is weighted at 46 near its rear end, the weight assisting the upturned front end 47 in preventing the shoe from any tendency to dig downwardly under the weight of accumulated snow. The shoe therefore acts somewhat like a caster wheel in that the weighted rear end of the shoe causes it to align with the forward motion of the vehicle, I shall therefore hereinafter refer to this aligning action as "caster."

The mouldboard 30 carries a bracket at 48 to which and to the mouldboard are attached rearwardly projecting ears 49, 50, 51, 52 for the vertically aligned pintle bolts 53, 54. To the bushing 55 rotatably mounted on the lower pintle 53, there is pivoted a triangular lever 56, the lower corner of which is fulcrumed at 57 to a pair of ears 58 upstanding from the shoe 45. The lever 56 may comprise a pair of laterally spaced plates as best shown in Fig. 3. Pivoted to the upper corner of lever 56 is a fitting 59 which carries the nut 60 into which is threaded a screw 61 adjustable by means of a handle 62 having radially projecting lever arms as shown in Fig. 4. The screw is held by a collar 63 to a yoke 64 pivoted to a sleeve 65 which is pivotal on the upper pintle 54. A keeper 66 pivoted to yoke 64 drops over one of the levers of the handle 62 to hold the screw in any desired position of adjustment. It will be obvious from Fig. 4 that by lifting the keeper to free the handle, the screw 61 may be rotated with a nut 60 to expand or contract the distance between lever 56 and sleeve 65 thereby raising or lowering the mouldboard with respect to the shoe. The similarity of the screw 61 and the nut 60 to jack-screw construction will be readily apparent and the construction will be referred to as a jack or jack screw. Likewise the similarity of construction of cylinders 70 and 96 to hydraulic jack construction will be noted and these devices will be referred to as jacks.

At the same time, the arrangement permits the shoe to trail or "caster" behind the vertical axis common to the pintle bolts 53, 54, so that in all positions of the mouldboard the shoe will be self-adjusting to ride with a minimum of resistance over the underlying surface and to provide support for the mouldboard at the adjusted level. As the shoes traverse the underlying surface, any irregularities therein will naturally cause oscillation of the mouldboard about its traverse fulcrum on the bolt 27 which connects it to thrust member 25, such movement being readily accommodated by the thrust bearing connections shown in Figs. 3, 5 and 6 and described above. The shoe construction is, of course, duplicated at both ends of the mouldboard, as shown in Fig. 3.

The angularity of the mouldboard is controlled by a horizontally disposed and pivotally mounted hydraulic ram which comprises a cylinder 70 pivoted on vertical trunnions 71, 72 pivoted in the angles 73, 74 which cross connect the uprights 19 of the sub-frame, as best shown in Fig. 1. The ram is double-acting, having hydraulic connections 75, 76 at its forward and rearward ends for the operation in well known manner of the plunger 77 which is connected by bolt 78 with the ears 79, 80 attached to the thrust member 25, as shown in Figs. 1, 2 and 5. Through suitable hydraulic connections and valves (not shown) the operator is able from the cab of the propelling vehicle to throw the mouldboard instantly from one side to the other to reverse its angle at the end of each traverse of the runway to be cleared of snow.

Means is also provided for lifting the entire mouldboard and its shoes from the earth for transportation from point to point. For this purpose chain anchorage plates 81, 82 are attached to the mouldboard or plow and chains 83, 84 extend thence to a common swivel fitting 85 suspended by links 86 from a hoist lever 87. This lever is mounted centrally of the vehicle on the angle 88 which cross connects a pair of upright angles 889 mounted directly to the frame 8 of the vehicle. The angle has a pair of up-

standing flanges 89, 90 spanned by a pintle 91 on which the lever 87 is fulcrumed (Figs. 1 and 2).

Another angle at 92 on the vehicle frame is centrally provided with similar flanges 93, 94 spanned by a pintle 95 upon which is fulcrumed the cylinder 96 of another hydraulic hoist mechanism, the plunger 97 of which is pivoted at 98 to the lever 87. A hydraulic connection is provided at 99 whereby, subject to the control of the operator, the lever 87 may be oscillated upwardly in a vertical central plane to lift the mouldboard together with its shoes 45 and the thrust member 25 and the sub-frame, all of these parts being guided for vertical upward movement by the parallel links 12 and 13. It is desirable that the swivel fitting 85 is pivoted to its supporting linkage 86 coaxially with the pintle bolts 23, 24, which pivot the thrust member 25 upon the sub-frame.

The mouldboard is ordinarily kept in either of its extreme positions of angular adjustment during use. In practice, it has been found desirable for the particular mouldboard shown to be set at an angle of approximately 50° from the longitudinal center line of the vehicle. At this angle, the height of the mouldboard from its cutting blade 41 to the upper edge thereof, and the curvature of the mouldboard as shown, are sufficient so that a particle of snow picked up at any point along the cutting blade 41 will travel in a helical path up and across the curved face of the mouldboard to the discharge end before reaching the top. In traversing this path, the particle of snow so picked up will follow a curve of uniformly decreasing radius and will therefore be uniformly accelerated all the way to the discharge point and will be discharged at maximum velocity. The high velocity discharge widely distributes all particles of snow and, as above noted, the plow is ordinarily used cross wind and arranged to discharge down wind so that the wind assists in distributing the particles of snow as widely as possible, none of them falling in the immediate vicinity of the path of the plow.

The freedom of movement of the mouldboard with respect to the mounting has already been described and is an important feature, effectually removing all excessive strains from the adjusting and controlling apparatus. The push bars or parallel links which communicate the thrust of the vehicle to the sub-frame and thence to the thrust member 25 to the mouldboard are relieved of all side thrust by the construction shown.

As distinguished from normal plowing operations which simply displace the plow sufficiently to clear a traveled roadway, and which ordinarily proceed at a speed such that the snow is merely displaced sufficiently for clearance, the improved plowing method contemplated by the present invention is conducted at as high a speed as is possible with the apparatus used, and with due consideration for the weight of the snow to be displaced. Every effort is made to develop sufficient speed so that the snow, instead of merely being pushed laterally, is actually lifted from the road and projected upwardly and outwardly from the end of the mouldboard at very high velocity sufficient not only to throw it clear of the runway of an airfield, so that it will not have to be moved again, but sufficient also to effect wide distribution of the snow so that the passage of the plow leaves no windrow whatever.

Since the ordinary runway to be cleared is many times wider than the plow, it is usually

necessary to make a number of traverses of the runway before the runway is clear. Each such traverse is made at comparatively very high rate of speed, which, in actual practice, has approximated at least 27 miles per hour. This compares with a speed of approximately ten miles per hour at which snow plowing operations have heretofore been conducted. The difference in speed results in a totally different kind of operation, since the purpose of ordinary plowing is merely to push the snow aside, whereas the result of plowing according to the present method is to lift the snow and project it to a distance. In each such traverse, the successive particles of snow encountered by the blade are impacted with sufficient velocity to lift them and cause them to travel a helical path upwardly and outwardly along the blade to be projected upwardly and outwardly from the end of the blade. The velocity of projection is such that substantially all of the snow encountered in each traverse will be hurled not only free of the runway, but distributed over a wide area therebeyond, thus avoiding formation of a windrow.

In ordinary plowing operations with conventional plows, the plowing operation is ordinarily started at the center of the road or runway, and the snow is pushed first to one side and then to the other until the entire area has been cleared, leaving the snow in windrows at opposite sides of the cleared path. According to the present method of operation, the plowing is preferably commenced at the upwind side of the runway or road to be cleared, and the plow is operated at a minimum speed of approximately 27 miles per hour, taking a cut of snow which is not too heavy to permit operation at the appropriate speed to raise and project such snow downwind beyond the runway and effect its distribution over a wide area. Arriving at the end of the path to be cleared, the vehicle is turned around, and the angle of the plow is reversed, thereby continuing to throw the snow downwind. As many traverses are made as may be required to complete the clearing of the runway to the desired width, throwing all of the snow to the downwind side of the runway and so distributing it as to leave no substantial windrow.

I claim:

1. For connection to a vehicle, a snowplow comprising a mouldboard having a rearwardly positioned bracket provided with a bearing surface, a thrust member having a complementary bearing surface and provided with a pintle connecting it upon a substantially horizontal axis with the mouldboard near the bottom thereof for relative movement of said bearing surfaces in a vertical plane, a sub-frame having pintle means connecting it upon a substantially upright axis with the thrust member whereby the thrust member and mouldboard can be oscillated unitarily from side to side respecting the sub-frame, and thrust links pivotally connected with the sub-frame and having means for pivotal connection to the vehicle for accommodating vertical movement of the snowplow respecting the vehicle.

2. The combination set forth in claim 1 in further combination with a lifting lever having means for mounting it on the vehicle to extend over said pintle means, a ram for the elevation of said lever, tension means connecting the lever and said mouldboard, and a coupling for said tension means on said lever, said coupling being in substantial axial alignment with the

pintle means and comprising means on which said tension means may swivelly move respecting the lever.

3. A plow adapted to be mounted at the front of a vehicle having a frame including transverse and upright members at the forward end thereof, said plow comprising the combination of upper and lower links at opposite sides of the frame pivoted to the upright members thereof and projecting forwardly, a sub-frame to which the respective links are pivoted to be guided by said links for upward and downward movement, said sub-frame comprising upper and lower forwardly projecting yokes, a thrust member provided with pintle means on an upright axis connecting it with said yokes near the center line of the vehicle, a mouldboard having a bracket and longitudinal pintle means disposed near the bottom of the thrust member and mouldboard and connecting the mouldboard with the thrust member for oscillation on an axis transverse to said upright axis, the thrust member and mouldboard having means providing bearing surfaces in engagement for accommodating such oscillation, flanges connected with one of said surfaces and overhanging the other for maintaining the mouldboard in a predetermined plane of oscillation, jack means connecting between said frame and the thrust member for regulating the angular position of the thrust member and mouldboard, and a hoist comprising a second jack means operatively connected for the lifting of said mouldboard thrust member and sub-frame upon said links.

4. The combination set forth in claim 3 in which the hoist means comprises a lever provided with a fulcrum disposed centrally behind the mouldboard, said lever projecting toward the mouldboard, a coupling connected with the lever in substantial alignment with the axis upon which the thrust member is oscillatable and a flexible connection from the coupling to the mouldboard for the lifting thereof, the second jack means being provided with a fixed support and extending thence to said lever, the location of said lever and coupling being such as to be adapted to lift the mouldboard irrespective of its angular position.

5. In a snowplow applicable to a vehicle frame having laterally spaced horizontal members and laterally spaced uprights, the combination with a mouldboard and means for adjustably connecting it with said frame comprising upper and lower links pivotally connected with the laterally spaced uprights, a sub-frame having uprights with which the respective links are pivotally connected for guiding the subframe for movement upwardly and downwardly, yokes connected with the uprights of the sub-frame and extending forwardly and laterally therebetween, said yokes extending around in front of the frame first mentioned, a thrust member pivoted between said yokes for oscillation upon a substantially upright axis and disposed directly in front of the center of the frame first mentioned, and a longitudinal horizontal pintle projecting forwardly from said thrust member and upon

which said mouldboard is oscillatably mounted.

6. The combination set forth in claim 5 in which the thrust member and mouldboard are provided with complementary bearing pads, certain of said pads remote from said last mentioned pintle having projecting margins and others of said pads having flanges interlocked about said margins whereby to define a predetermined plane of oscillation of the mouldboard upon said last mentioned pintle.

7. The combination set forth in claim 5 in further combination with a transverse support between the uprights of the sub-frame, a jack cylinder pivoted upon said support for lateral oscillation in a horizontal plane, and a piston rod projecting from the cylinder and operatively connected with the thrust member for the oscillation thereof.

8. A snow plow adapted to be mounted at the front of a high speed vehicle having a frame, said snow plow comprising the combination with a mouldboard having a mounting bracket on its rear surface, of a thrust member in thrust relation to said bracket, said thrust member being provided with a vertical pivot connected to the vehicle frame for articulation of the thrust member and mouldboard in a horizontal plane and a horizontal pivot connected to the mouldboard mounting bracket and upon which the mouldboard is pivotally mounted for articulation of the mouldboard independently of the thrust member in a vertical plane, and casters connected to the mouldboard at opposite sides of said horizontal pivot whereby to articulate the mouldboard independently of the thrust member about said horizontal pivot in response to ground irregularities.

9. The device of claim 8 in which said vehicle frame comprises parallelogram links pivotally connected to said vehicle for movement in a vertical plane, and means for fixing the position of said links whereby to adjust the height of the mouldboard respecting the ground.

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