June 8, 1943. LE GRAND H. LULL 2,321,401

HIGHWAY SHOULDER GRADER

Filed April 17, 1941 3 Sheets-Sheet 1

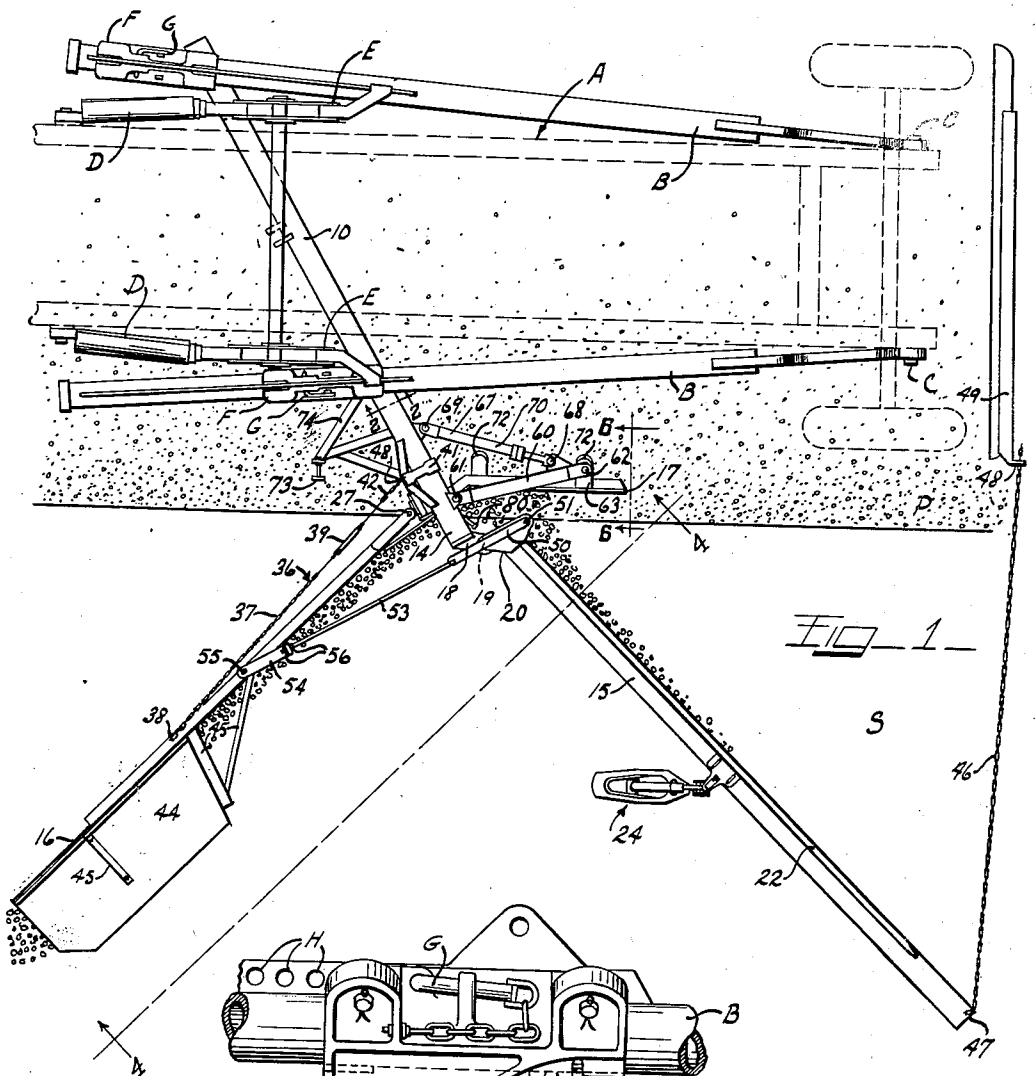


FIG. 1

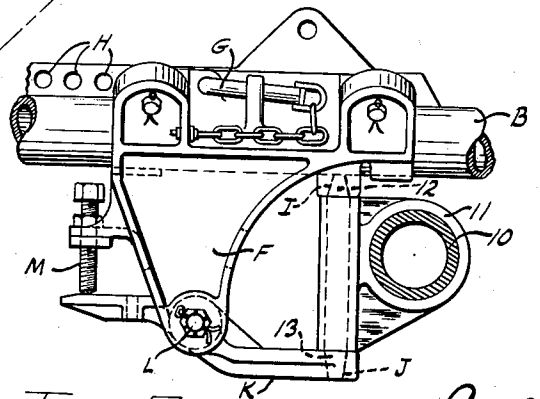


FIG. 2

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FIG. 3.

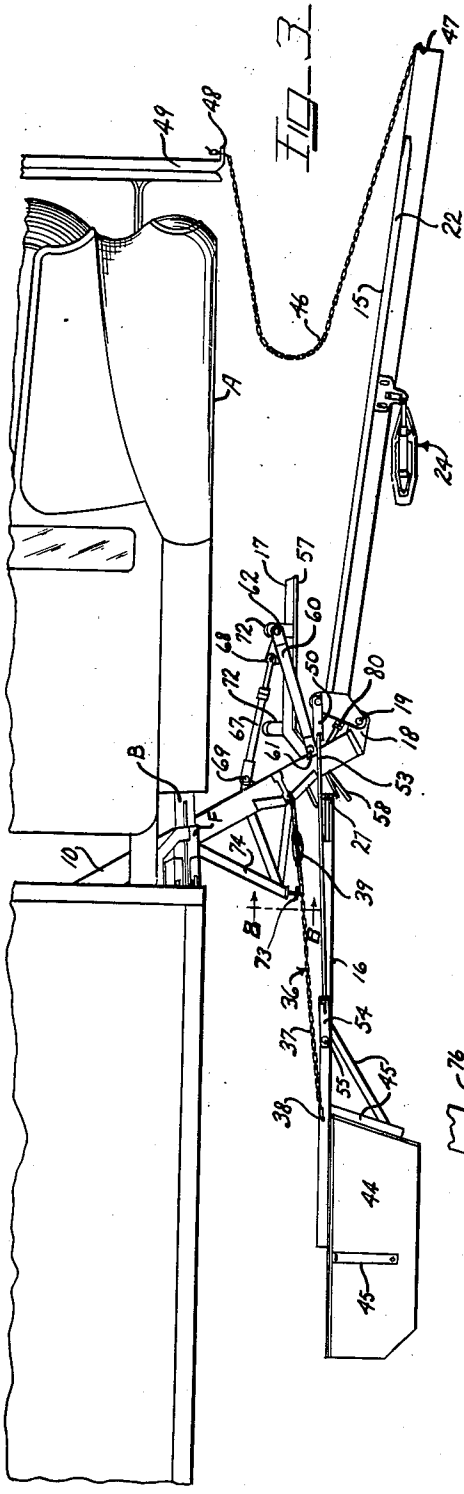


FIG. 4.

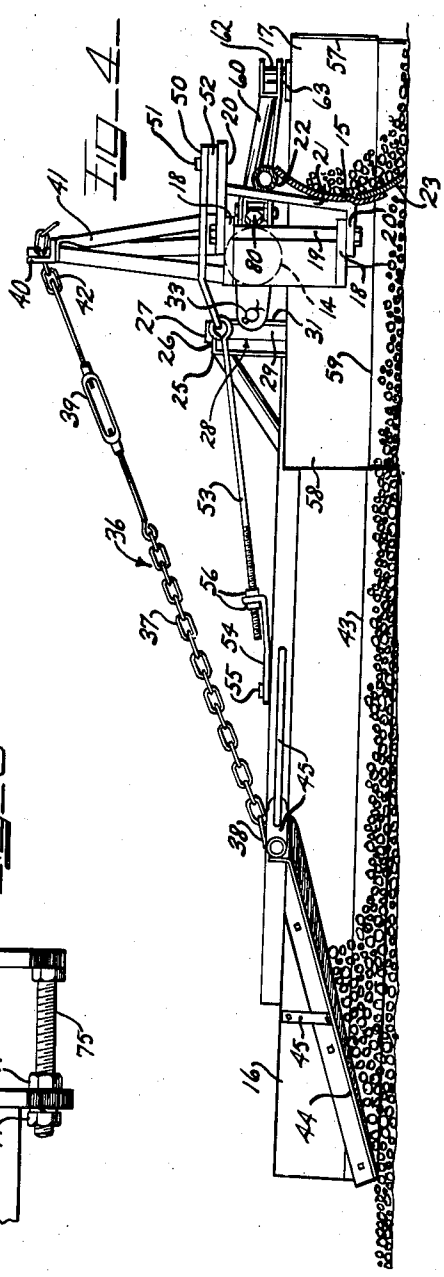
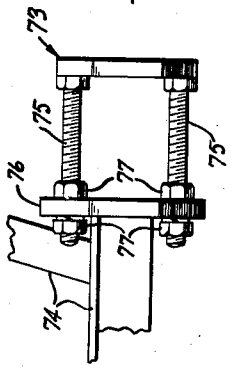


FIG. 8.



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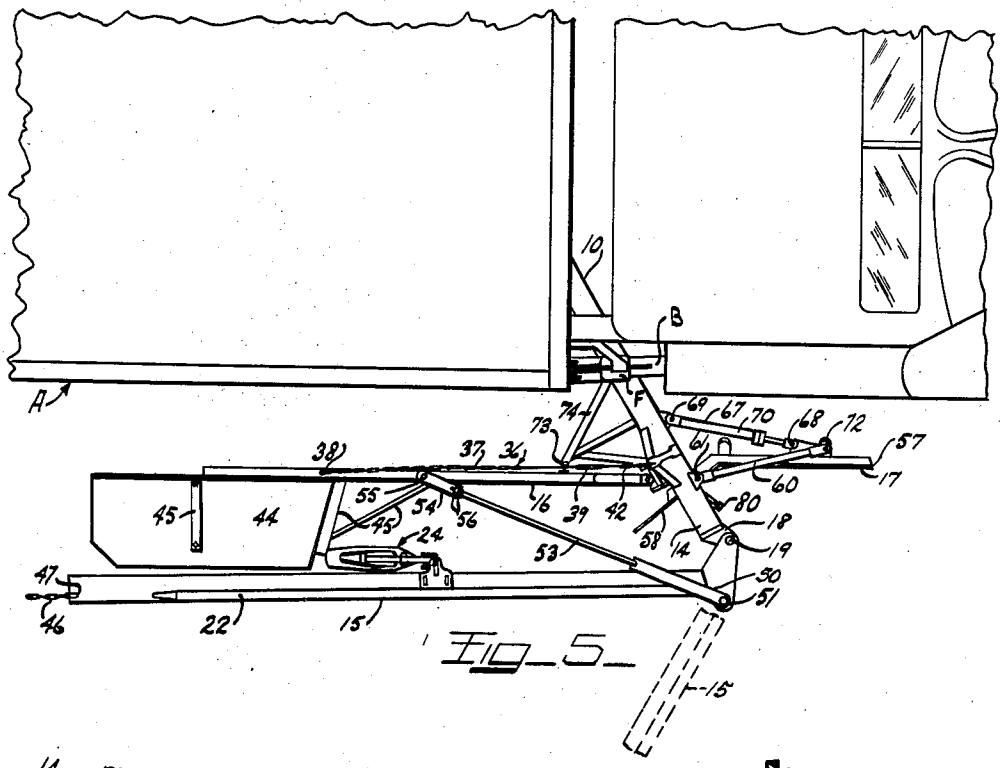


Fig. 5

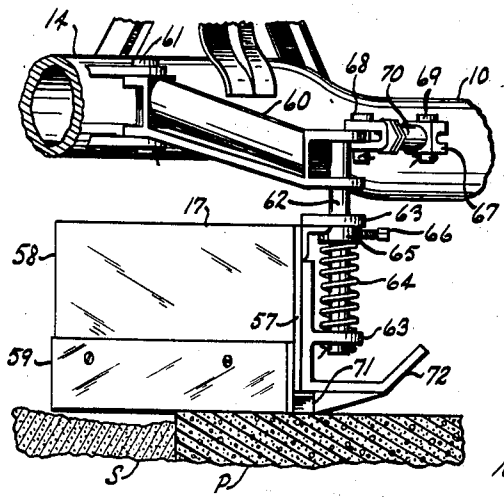


Fig. 6

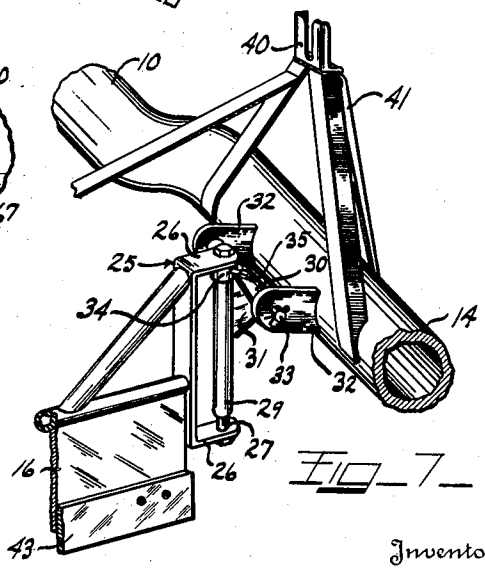


Fig. 7

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2,321,401

HIGHWAY SHOULDER GRADER

Le Grand H. Lull, Minneapolis, Minn.

Application April 17, 1941, Serial No. 388,940

32 Claims. (Cl. 37—155)

This invention relates generally to improvements in road grading equipment and more particularly to a grading apparatus for conditioning and maintaining the shoulders of paved and hard surfaced highways.

The usual paved highway, except where it runs between safety fences or culverts, is bounded on each side by an unpaved, more or less level, strip of earth which is called the shoulder. This shoulder is of such width that a vehicle may be driven off thereon to clear the highway and this action, particularly where the shoulder is damp, causes the formation of ruts which are unsightly and dangerous. The primary object of my invention therefore is to provide a grader which may be carried and operated by a motor truck or similar vehicle traveling on the highway and which projects from the truck laterally in order to grade and condition the shoulder alongside which the truck is driven.

Another object is to provide shoulder maintaining equipment of this kind including a plurality of grader blades or boards which are arranged to first grade the shoulder and then move the accumulated earth toward the highway to fill in all ruts, especially those immediately alongside the paved slab, and then to distribute any excess earth outwardly again evenly and smoothly in such manner as to prevent the formation either of a furrow or windrow of earth at the outer limit of the graded strip.

Another object is to provide a moldboard mounting and construction such that the earth in addition to being moved outwardly from the highway as above will also be prevented from forming a ridge or crown on the graded strip or shoulder.

Another and important object is to provide a shoulder conditioner having mounting and supporting means so arranged that the normally laterally extending moldboards may be easily and automatically swung inward alongside the truck to clear and pass a highway fence or culvert, narrow bridge, or the like without requiring that the motor truck be driven out of the right hand lane on the highway into the path of approaching traffic.

Still another object is to provide a shoulder maintainer in which the moldboards may be readily adjusted to proper working angles, having interconnecting linkage to preserve proper relative angles over any range of adjustment and may be compactly folded for transport purposes. Other objects reside in provision of convenient mounting means for the shoulder grader as a whole and other novel details of construction which will be made apparent in the course of this specification.

These and other more detailed and specific objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

Fig. 1 is a plan view showing my improved shoulder grader in operating condition. The draft bars and other supporting parts are shown and parts of the operating vehicle or motor truck are indicated in dotted lines.

Fig. 2 is an enlarged cross section along the line 2—2 in Fig. 1.

Fig. 3 is a fragmentary plan view of the motor truck or vehicle and showing the moldboards folded to what may be termed their passing positions or in which they fold in opposite directions closely alongside the truck for passing highway fences, culverts and the like.

Fig. 4 is an enlarged sectional view taken along the line 4—4 in Fig. 1.

Fig. 5 is a view similar to Fig. 3 but showing the moldboards swung rearwardly alongside the vehicle for transporting.

Fig. 6 is an enlarged front end elevation of the pavement moldboard, showing a section through the pavement edge and adjacent shoulder and with the major portion of the supporting cross member broken away.

Fig. 7 is an enlarged fragmentary perspective view of the universal joint mounting of the rear moldboard and adjacent parts.

Fig. 8 is a detail of the adjustable stop member for limiting inward swinging movement of the rear moldboard.

Referring now more particularly to the drawings my shoulder conditioning and maintaining apparatus is shown as associated with a motor truck or vehicle which is indicated generally at A and beneath or to which the draw bars B are pivotally connected at forward ends C. Said draw bars extend rearwardly and longitudinally from their pivoted forward ends and may be raised or lowered about the pivots by any suitable means such as the hydraulic jacks D connected through links E to the bars. The bars also have freedom for limited swinging movements in transverse planes. Mounted on each draw bar is a roller equipped knee or movable mounting bracket F which may be adjusted forwardly or rearwardly and secured in adjusted position by insertion of a pin G in any of the openings H. Each knee, as shown in Fig. 2, has an upper socket I and lower socket J in vertical

alignment and said lower socket is formed in an arm K fulcrumed at L and movable upwardly and downwardly by the screw M. The foregoing structure forms a part of an under chassis type of motor grader of a well known type and since it forms no part of the present invention the structure will not be further detailed herein.

My invention comprises a cross member or carrier member 10 in the form of a hollow tube and which at spaced points is equipped with collars 11 having upper and lower cone-shaped pins 12 and 13 (Fig. 2) adapted to be received in the aforesaid sockets I and J to thereby mount the member on the knees F. For this purpose the arm K may be swung downward to receive the pins 12 and 13 and then, by adjusting the screw M, the sockets may be readily engaged with the pins as should be apparent. At the right hand end the member 10 extends outwardly from the vehicle A some distance and is offset to dispose its end portion 14 upwardly and provide adequate operating space therebeneath. Obviously by shifting the knees F forwardly and rearwardly on the draw bars B the member 10 may be angled forwardly or rearwardly with respect to the vehicle and by operating the jacks D this member may be raised and lowered at either or both ends as may be desired. The latter operation, particularly in that it tilts the member 10 in the transverse vertical plane, is of importance in my invention as will presently appear.

The shoulder conditioner per se includes as its main element a forward cutting moldboard or blade 15, a rear spreading moldboard 16 and an inner or pavement moldboard or stop plate 17. The forward moldboard 15 is pivotally mounted on the extremity of the cross member 10 for movement in a horizontal plane about a vertical pivot axis and for this mounting I provide the outer end portion 14 of the cross member with rigidly mounted and braced upper and lower mounting lugs 18 apertured to pass the upright pin 19 which pivotally engages the inwardly turned hinge lugs 20 rigidly mounted on the inner end of the moldboard. A brace member 21 rigidly anchors the upper hinge lug.

This moldboard 15 has a bracing tube 22 welded along its upper edge and is provided with the usual replaceable cutting edge 23 along its lower margin. Also this moldboard is provided with a levelizer designated generally at 24 which is similar to those shown in my prior Patents Nos. 1,968,412 and 2,108,541, and which serves to prevent chattering of the blade when it is cutting.

The rear spreading moldboard 16 is mounted not only for horizontal swinging movements but for up and down movements at its outer or free end. The inner end of the moldboard thus carries a rigidly mounted bracket 25 having upper and lower apertured lugs 26 adapted to receive a vertically axised pivot pin 27. A universal block 28 has a tubular bearing 29 of a length less than the space between the lugs 26, which rotatably engages the pin 27 and said block further has a tubular bearing 30 disposed at right angles to the aforesaid bearing 29 and rigidly connected thereto by the diamond-shaped plate 31. The latter bearing 30 fits between apertured ears 32 rigidly affixed and rearwardly extended from the member 10 inwardly of its outer end. A pin 33 passed through these ears 32 and the bearing 30 then connects the rear moldboard to the member 10 and, of course, the two pivot pins 27 and 33 permit of the desired swinging movement of the moldboard in both horizontal and vertical planes. The mounting however, is such that the moldboard cannot tilt forwardly or rearwardly due to the contact between its lower edge and the road surface.

Attention is directed to the fact that, above the bearing 29, a collar 34 is secured by a set screw 35 on the pin 27 and by raising and lowering this collar the rear moldboard may have its inner end lowered or raised, respectively, with respect to the member 10.

To further support the rear moldboard and limit downward movement of its outer end I provide a flexible support member 36 made up of a chain 37 secured at one end at 38 to an outer upper edge portion of the moldboard and connected at its other end to a turn-buckle 39. A slotted fork 40 is supported by a turret frame or tower 41 approximately over, and well above, the universal block 28 and a short length of chain 42 may have any of its links secured in the fork as clearly shown in Fig. 4. The turret frame 41 is, of course, erected rigidly from the member 10 and the flexible member 36 may thus be readily adjusted to support the weight of the outer end portion of the moldboard limiting downward movement but interfering in no way with upward movement thereof. Rough adjustments may be made by the links of the chain 42 while finer adjustments are made by the turnbuckle 39.

The rear moldboard 16 also has a replaceable cutting edge 43 and on the outer end portion there is mounted an outwardly sloping, substantially rectangular spreader or feathering plate 44 which extends forwardly from the board and at its outer end terminates substantially flush with the end of the board. This plate 44 is rigidly braced to the moldboard as represented at 45, and the outer end of the plate falls substantially flush with the lower edge of the moldboard.

The forward moldboard 15 in cutting position angles forwardly and outwardly from its pivot mounting 19 and to retain it in such position I provide a draft chain 46 which is secured at the outer end of the board at 47 and extends forwardly and inwardly therefrom to a hook 48. This hook may be engaged with a cross bar 49 secured to the bumper of the truck A as clearly shown and obviously by varying the length of the chain 46 the working angle of the moldboard may be changed as desired. The chain limits rearward swinging movement of the moldboard for this purpose but, of course, permits forward swinging movement as will presently appear.

The rear moldboard 16 is held in working position by a novel connection to the forward moldboard and which comprises a link 50 pivoted at one end at 51 to an extension 52 of the upper hinge lug 20. A link rod 53 extends from the link 50 to a short tie bar 54 pivoted at 55 to an upper medial edge portion of the rear moldboard, the end of the rod having threaded nuts 56 to permit the convenient adjustment of the overall length of the parts 50, 53 and 54. The pivot 51 is offset or eccentric to the pivot 19 for the forward moldboard and in the working position of said forward moldboard the pivot 51 is positioned well forward and slightly inward of the pivot 19. The link 50 and other parts of the connection thus serve to pull forwardly against the rear moldboard and hold it in its rearwardly and outwardly angle working position, as will be clearly apparent in Fig. 1.

The pavement or stop moldboard 17 has a straight forward end 57 and outwardly and rear-

wardly angled rear end or tail 58 both of which have the replaceable cutting edge 59 shaped to fit. A torque arm 60 is pivoted at 61 on a forward side of the end portion 14 of the cross member 10 and extends forwardly to a pivot arm and within an upper forward edge portion of the moldboard 17 where the arm carries a rigid vertically axised pin 62. The forward moldboard end 57 has on its inner side the upper and lower inwardly turned bracket lugs 63 which are apertured to slidably receive the depended end of the pin 62 (see Fig. 6) and an expansion coil spring 64 is placed over the pin between said lugs. Above the spring and below the uppermost lug 63 a collar 65 is placed on the pin and may be adjusted upwardly or downwardly thereon by a set screw 66.

The aforesaid mounting obviously permits some swinging movement of the moldboard 17 in a horizontal plane about the axis of the pin 62 and the spring 64 normally and yieldably urges the moldboard downwardly. The latter movement is limited by contact of the upper lug 63 with the collar 65 and obviously by moving this collar up or down the moldboard may be raised or lowered and adjustments of the tension of the spring 64 may be made.

The torque arm 60 is braced and held in forwardly extending position by means of a brace arm or link 67 pivotally connected at 68 and 69 to the arm and member 10 and adjustable in length through the telescopic connection 70.

The forward end 57 of the pavement moldboard has an inner strip 71 along its lower edge and extending upwardly and inwardly therefrom are the guide shoes 72, the purpose of which will presently appear.

At the rear of the cross member 10 and inwardly of the moldboard 16 I provide a stop pad 73 which is mounted on a rigid frame 74 secured to said member 10. At each end the pad 73 has threaded studs 75 which are passed through openings in the end of a plate 76 rigid on the frame 74 and by adjusting nuts 77 on these studs the pad may obviously be moved inward or outward with respect to the truck A in position to engage the rear moldboard as it swings inwardly. This operation will presently be made clear.

In operation the front and rear moldboards 15 and 16 are arranged in the respectively forwardly and rearwardly angled positions and the truck A is then driven along the right hand lane of the highway pavement, P in Fig. 1, so that the moldboards extend out over the shoulder S. The two moldboards 15 and 16 are substantially at right angles to each other but the inner end of the forward moldboard stands forwardly and outwardly from the corresponding inner end of the rear moldboard. In this position the rear end 58 of the pavement moldboard 17 then extends rearwardly over the forward side of the inner end of the rear moldboard in contact therewith. The truck or vehicle is driven so that the straight forward end 57 of the pavement moldboard, having the runner 71, moves along the pavement in contact therewith and a short distance from the edge as clearly shown.

The draw bars B are of course lowered or adjusted so that the forward moldboard 15 will make the desired cut, whereupon the earth then graded will be caused by the angle of the moldboard to move inwardly toward the pavement. As the earth is thus thrown inwardly it will at least partially, fill all ruts or depressions, particularly those immediately alongside the pavement, and the excess earth will flow from the inner end of the moldboard back to the rear moldboard 16 for redistribution outwardly thereby completing the filling of any ruts or depressions not previously filled by the forward moldboard. The pavement moldboard 17 will prevent the earth from moving inward over the pavement and will guide the earth off the edge of the pavement and to the rear moldboard. The forward moldboard has a true cutting edge and is set to cut off all high points. The board is always so set that it will move more earth than required to fill all depressions in order that a sufficient quantity of the earth will reach the edge of the pavement and insure the filling of the ruts therealongside.

As the loose earth flows along the rear moldboard rearwardly and outwardly it will move under the spreader plate 44 and exert an upward pressure thereon such that the outer end of this moldboard will be moved upwardly. As best seen in Fig. 4 this angular movement and positioning of the moldboard 16 causes the earth to be spread or feathered evenly and outwardly leaving a perfectly smooth shoulder and with no furrow or windrow at the outer edge of the graded strip. The earth is further so distributed and dropped that no crown or ridge will be found on the graded strip. The relatively wide rear end or edge of the plate 44 is obviously important as it prevents escape of the earth without properly raising the moldboard and by crowding and confining the earth prevents it from rolling upwardly over the outer end portion of the plate.

It will be noted that the forward moldboard, which does the actual grading may extend outward some distance beyond the rear moldboard and thus the material feathered outwardly from beneath the spreader plate 44 may just nicely fill the outer edge of the graded strip. The adjustment at 56 however, permits the rear moldboard to be adjusted to drop the material, particularly the larger pieces, either at the outer end as described or nearer the pavement, at the will of the operator.

Should the pavement moldboard 17 be accidentally moved off the edge of the pavement by misdirection of the vehicle the shoes 72 will readily guide it back over the edge when the vehicle is steered in a direction toward the center of the pavement as will be readily understood.

Along most highways the grader will frequently encounter obstacles on the shoulder such as highway fences, culverts, narrow bridges, or the like, and to pass same, it is, of course, neither safe nor desirable to drive the vehicle out of its right hand lane over into the path of approaching traffic. By my novel mounting and interconnection of the parts I avoid the necessity for such travel as follows:

The operator by raising the right hand draw bar B (next to the grader) and lowering the other, may tilt the entire grader in the transverse plane, meanwhile raising it from the ground. The weight of the forward moldboard 15 will then cause it to automatically swing inward toward the vehicle and this operation, carrying the pivot 51 inwardly and to the rear, will cause the rear moldboard 16 to also fold toward the vehicle due to the end thrust on the link 50. An adjustable stop 80 on the forward side of the member 10 will engage the brace 21 on the forward moldboard to limit the folding movement. As a result the moldboards assume the passing position of Fig. 3 close against the vehicle and clear of any obstructions upon the highway shoul-

der. When past the obstruction, the draw bars A are then restored to normal positions and the contact of the forward moldboard with the ground will then swing it back to operating position (limited by the chain **46**) and the pull exerted upon the link **50** by the forwardly shifted pivot **51** will pull the rear moldboard **16** forwardly to its working position. It is thus unnecessary for the operator of the vehicle to do more than manipulate the controls (not shown) for the jacks D to fold and unfold the grader as required.

Obviously the stop **80** may be adjusted as required to limit the folding of the moldboards to the point that they will clear the vehicle and prevent any damage.

The width of the graded strip may be readily varied according to the width of the shoulder by adjusting the chain **46** to angle the forward moldboard as may be required and such adjustments will always cause a corresponding and properly proportional positioning of the rear moldboard by action of the pivot **51** on link **50**. However, as stated heretofore, the rear moldboard **16** may be independently adjusted to the desired angle by manipulation of the nuts **56** on the link rod **53**.

For transporting, the chain **46** is disconnected and, with the grader raised from the ground, the forward moldboard **15** is swung by hand around to the rear. As this is done the pushing force exerted on the link **50** by the pivot **51** moving outwardly and rearwardly will swing the rear moldboard inwardly until stopped by the pad **73**. As shown in Fig. 5 the moldboards will thus stand substantially parallel and close in to the side of the vehicle. The chain **37** may now be tightened if desired to have greater road clearance while transporting and the stop pad **73** may be adjusted to provide adequate clearance between the moldboard **16** and the truck body and tires. The chain **46** will be conveniently used at this time to tie the moldboards to the truck and prevent outward swinging.

It is to be noted that my device is not a shoulder shaper and is used only to condition and maintain the shoulder in whatever shape or contour it may have been originally worked into by the usual equipment for such purposes. In this connection, it will be apparent that the transverse tilting of the beam **10** as described will permit the moldboards to be angled according to the transverse slope or inclination, if any, of the shoulder.

Under some circumstances, for example where the shoulder has been worked by hand and fills made leaving some large bumps or particles on the surface, the forward moldboard **15** may be disposed in the rearwardly angled position, shown by the dotted lines in Fig. 5 (with the rear moldboard **16** swung alongside the truck), and the larger particles will be run out and discharged at the outer edge of the shoulder. The levelizer **24** holds the moldboard at the desired vertical adjustment to drop any small particles in this operation.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is:

1. A grader of the character described, comprising the combination with a wheeled frame, of front and rear moldboards supported on the frame and disposable in forwardly and rearwardly angled working positions respectively, the said moldboards being foldable forwardly and rearwardly about inner end pivot connections, means for adjusting the angle of one moldboard, and means connecting the moldboards to cause corresponding folding movements of both in response to adjustment of said one moldboard.

2. A grader of the character described, comprising the combination with a wheeled frame, of front and rear moldboards each supported at one end on the frame and arranged to be positioned in forwardly and rearwardly angled working positions respectively, the said moldboards being foldable forwardly and rearwardly about inner end pivot connections, means for foldably adjusting the front moldboard forwardly or rearwardly to control the width of the strip graded thereby, and means connecting the moldboards to cause opposite and substantially equal folding adjustments of the rear moldboard in response to adjustment of said front moldboard.

3. A grader of the character described, comprising the combination with a wheeled frame, of front and rear moldboards each supported at one end on the frame and extending from these ends in forwardly and rearwardly angled working positions respectively, the said moldboards being foldable forwardly and rearwardly about inner end pivot connections, means for adjusting the front moldboard forwardly or rearwardly to thereby control the working angle thereof, and link means connected between the front and rear moldboards and operative to adjust the rear moldboard in accordance with adjustments of the front moldboard and maintain the outer end of the rear moldboard inwardly of the path of the outer end of the front moldboard.

4. A highway shoulder grader comprising the combination with a wheeled frame, of front and rear moldboards each pivotally supported at one end from the frame and swingable about said connections to respectively forwardly and rearwardly angled working positions with respect thereto, the front moldboard being adapted to grade and move earth inwardly from the shoulder toward the highway and the rear moldboard to receive such earth and return it outwardly over the surface of the shoulder, the said rear moldboard being also pivoted about its inner end for upward and downward movement at its outer end, and means on the rear moldboard for urging the outer end thereof upwardly in response to the accumulation of earth thereat.

5. A highway shoulder grader comprising the combination with a wheeled frame, of front and rear moldboards each pivotally supported at one end from the frame and swingable about said pivotal supports to respectively forwardly and rearwardly angled working positions, the front moldboard being adapted to grade and move earth inwardly from the shoulder toward the highway and the rear moldboard to receive a part of such earth and return it outwardly over the shoulder, the said rear moldboard being also mounted for upward and downward movements at its outer end, and means on the rear moldboard adjacent its outer end responsive to the height of earth accumulated thereat for urging said outer end upward.

6. A highway shoulder grader comprising the combination with a wheeled frame, of front and rear moldboards supported from the frame in laterally extending positions and swingable about inner end pivot connections to respectively for-

wardly and rearwardly angled working positions, the front moldboard being adapted to grade and move earth inwardly from the shoulder toward the highway and the rear moldboard to receive a part of such earth and return it outwardly over the shoulder, the said rear moldboard being also mounted for upward and downward movements at its outer end, and a spreader plate supported in outwardly and downwardly sloping position on the forward side and outer end portion of the rear moldboard and acting to urge said outer end upward in response to the accumulation and outward movement of earth beneath the plate.

7. A highway shoulder grader, comprising the combination with a wheeled frame adapted to travel the highway, of front and rear moldboards supported in laterally extending positions from the frame and swingable about inner end pivot connections to respectively forwardly and rearwardly angled working positions over the highway shoulder, a transverse mounting member on the frame having at one end the said pivot connections, and means for transversely tilting said mounting member to raise it at the end having said connections and angle the front and rear moldboards upwardly at their outer ends whereby they will of their own weight fold about their inner end pivot connections toward the frame to thereby clear obstructions on the shoulder.

8. A highway shoulder grader comprising a wheeled frame, a mounting member supported thereon, front and rear moldboards supported by inner end pivot connections from said member and extending laterally outward therefrom in normal forwardly and rearwardly angled working positions respectively, the front moldboard being foldable either forwardly toward the vehicle or rearwardly around alongside the rear moldboard, and means connecting the moldboards to cause the rear moldboard to swing toward the frame in response to either forward or rearward folding movements of the front moldboard from the working position.

9. A highway shoulder grader comprising a wheeled frame, a mounting member supported thereon, front and rear moldboards supported by inner end pivot connections from said member and extending laterally outward therefrom in normal forwardly and rearwardly angled working positions respectively, the front moldboard being foldable either forwardly toward the vehicle or rearwardly around alongside the rear moldboard, means connecting the moldboards to cause the rear moldboard to swing toward the frame in response to either forward or rearward folding movements of the front moldboard from the working position, and stop means for limiting the folding movements of the moldboards toward the frame.

10. In a highway shoulder grader, front and rear moldboards arranged for travel along the shoulder in respectively forwardly and rearwardly angled positions, the said front moldboard being adapted to grade the shoulder and move the earth toward the highway and the rear moldboard to return the earth outward and spread it over the shoulder, means on said rear moldboard for urging the outer end upwardly about an inner end pivot connection in response to the action of the outwardly moving earth to thereby feather the earth out over the shoulder, and means for limiting downward movement of the rear moldboard about said inner end pivot connection.

11. The combination in a highway shoulder grader comprising a front moldboard angled to throw graded earth from the shoulder toward the highway and a rear moldboard angled to return excess earth outwardly, of an inner moldboard disposed to limit inward movement of the graded earth from the front moldboard and guide the earth outward ahead of the rear moldboard, the said inner moldboard having a forward portion adapted to run on the highway inwardly of the shoulder and disposed substantially parallel with the direction of travel, and upwardly yieldable means for urging the said forward portion continuously into contact with the highway.

12. The combination in a highway shoulder grader comprising a front moldboard angled to throw graded earth from the shoulder toward the highway and a rear moldboard angled to return excess earth outwardly, of an inner moldboard disposed to limit inward movement of the graded earth from the front moldboard and guide the earth outward ahead of the rear moldboard, the said inner moldboard being adapted to run on the highway inwardly of the edge thereof, and inwardly and upwardly angled guide shoes on the inner side of the moldboard.

13. A grader for maintaining the shoulder alongside a highway pavement, comprising the combination of a wheel borne supporting and operating frame, a front moldboard angled to throw graded earth toward the pavement, a rear moldboard angled to throw earth received from the front moldboard outwardly away from the pavement, both of said moldboards being supported and operated outwardly of the side of the pavement upon the shoulder, and an inner moldboard supported and positioned to run along the lateral edge portion of the pavement to limit the inward movement of earth by the front moldboard and deflect such earth back into the path of the rear moldboard, the said inner moldboard being spring mounted for yieldable upward movements relative to the front and rear moldboards.

14. A grader for maintaining the shoulder alongside a highway pavement, comprising the combination of a wheel borne supporting and operating frame, a front moldboard angled to throw graded earth toward the pavement, a rear moldboard angled to throw earth received from the front moldboard outwardly away from the pavement, both of said moldboards being supported and operated outwardly of the side of the pavement upon the shoulder, an inner moldboard positioned to run along the lateral edge portion of the pavement to limit the inward movement of earth by the front moldboard and deflect such earth back into the path of the rear moldboard, and the said inner moldboard being supported for adjustments in a horizontal plane with respect to the inner ends of the other moldboards.

15. A grader for maintaining a highway shoulder, comprising a transport frame, front and rear moldboards extending outwardly and laterally from the frame for travel along the shoulder and normally disposed in respectively forwardly and rearwardly diverging working angles, the said moldboards being movable about generally upright axes at their inner ends and adapted to swing inwardly toward folded positions alongside the frame, and supporting means connected to the frame and moldboards and operative for tilting the said pivot axes of the moldboards inwardly at upper ends whereby the moldboards will swing toward such folded positions of their own weight.

16. A grader for maintaining a highway

shoulder, comprising a transport frame, front and rear moldboards extending outwardly and laterally from the frame for travel along the shoulder and normally disposed in respectively forwardly and rearwardly diverging working angles, supporting means connected to the frame for supporting the moldboards, the said moldboards being foldable about generally upright axes connecting their inner ends to the said supporting means and adapted to swing in opposite directions inwardly toward folded positions alongside the frame, and means for adjusting said supporting means to tilt the said axes inwardly at upper ends whereby the moldboards will of their own weight swing toward said folded positions.

17. A grader for maintaining a highway shoulder, comprising a transport frame, front and rear moldboards extending outwardly and laterally from the frame for travel along the shoulder and normally disposed in respectively forwardly and rearwardly diverging working angles, the front moldboard being movable inwardly and forwardly from said working angle, the rear moldboard being oppositely movable rearwardly and inwardly, means supporting inner ends of the moldboards from the frame and having pivot connections with the moldboards, and means for tilting the said pivot connections to angle the moldboards upwardly toward outer ends whereby they will fold inwardly by the effect of gravity.

18. A grader for maintenance work on a highway shoulder, comprising a wheeled frame, front and rear moldboards supported about inner end pivot connections with the frame and normally disposed in outwardly extending and respectively forwardly and rearwardly angled working positions for movement along the shoulder in grading engagement therewith, the said front and rear boldboards being connected for opposite folding movements and movable inwardly from said working positions toward folded positions alongside the frame, means for elevating the moldboards clear of the shoulder for such folding movements, and the first front moldboard in folded position extending outwardly and forwardly to an angle sufficient to cause it to swing back toward working position when its outer end is lowered into engagement with the shoulder.

19. A grader for maintaining highway shoulders, comprising a traveling frame, front and rear moldboards supported from the frame for movement along the shoulder in grading engagement therewith and disposable at opposite working angles whereby the front moldboard will move graded earth toward the highway and the rear moldboard will move earth back outwardly and discharge excess earth at its rear end, the rear moldboard being also arranged for upward floating movements at its rear end, and means for moving said rear end of the moldboard upwardly in response to an accumulation of earth thereat to thereby discharge a portion of such earth beneath the moldboard.

20. A grader for maintaining highway shoulders, comprising a traveling frame, front and rear moldboards supported from the frame for movement along the shoulder in grading engagement therewith and disposable at opposite working angles whereby the front moldboard will move graded earth toward the highway and the rear moldboard will move earth back outwardly and discharge excess earth at its rear end, the rear moldboard being also arranged for upward movements at its rear end relative to its forward end, means actuated by the accumulation of earth moving off said rear end for elevating the end to permit the escape of a part of that earth beneath the moldboard, and means for adjusting the relative operating levels of the ends of the rear moldboard.

21. A device for grading highway shoulders, comprising a wheeled frame, a supporting member on the frame, front and rear moldboards supported from said member in normally reversely angled working positions, the said front moldboard being foldable about a pivot connection at one end with said member either forwardly or rearwardly from said working position, the rear moldboard being similarly supported about a pivot connection at one end for forward and rearward folding movements, means connecting the moldboards and operative to fold the rear moldboard in a rearward direction from said working position in response to either forward or rearward folding movements of the front moldboard, and said connecting means being adjustable to vary the relative working angles of the moldboards.

22. A device for grading highway shoulders, comprising a wheeled frame, a supporting member on the frame, front and rear moldboards supported from said member in normally reversely angled working positions, the said front moldboard being foldable about a pivot connection at one end with said member either forwardly or rearwardly from said working position, the rear moldboard being similarly supported about a pivot connection at one end for forward and rearward folding movements, a link device connected at one end to the rear moldboard and connected at the other end to the front moldboard at a point located eccentric to and normally forwardly of the pivot connection thereof whereby either forward or rearward folding movements of the front moldboard from said normal working position will exert an endwise rearward movement on the link device to fold said rear moldboard in a rearward direction.

23. A grader for maintaining highway shoulders, comprising a wheeled frame, front and rear moldboards supported on the frame and foldable about pivot connections therewith from normal reversely angled working positions to folded positions alongside the frame, and an adjustable stop device for engaging the front moldboard to limit folding movements thereof.

24. A grader for maintaining highway shoulders, comprising a wheeled frame, front and rear moldboards supported on the frame and foldable about pivot connections therewith from normal reversely angled working positions to folded positions alongside the frame, and an adjustable stop device arranged to engage the rear moldboard to limit folding movements thereof.

25. In a highway shoulder grader, a transport frame, front and rear moldboards supported at one end from the frame and disposable at adjustable reversely angled working positions, and means at the center portion of the front moldboard for engaging the ground and supporting the moldboard for grading movement thereon.

26. In a grader, a moldboard operatively arranged and angled to move earth from a forward end toward and off its trailing end, the

said moldboard being also supported for up and down movements at its trailing end with respect to its forward end, a substantially rectangular plate member secured to the forward side of the moldboard adjacent its trailing end and in a sloping position whereby an accumulation of earth beneath said plate member will elevate the rear end of the moldboard to permit the escape of a part of such earth beneath the lower edge of the moldboard.

27. In a grader, a moldboard operatively arranged at a working angle to move earth from its forward end rearwardly off its trailing end, the said moldboard being also supported for floating movements at its trailing end relative to its forward end, a plate member arranged lengthwise on the forward side of the moldboard adjacent its trailing end and sloping toward the said trailing end, the said member having a rear edge at least as wide as its forward edge to thereby confine and crowd the earth moving off the trailing end of the moldboard beneath the member and cause an accumulation of such earth to exert a lifting force on the trailing end of the moldboard.

28. A grader for maintaining the shoulder alongside a highway pavement, comprising a traveling frame, a front moldboard connnected to the frame for movement over the shoulder and angled to throw graded earth toward the pavement, a rear moldboard connected to the frame and arranged to throw graded earth received from the front moldboard outwardly away from the pavement, an inner moldboard arranged to ride upon the pavement and to limit the inward movement of the earth from the front moldboard, and supporting means for said inner moldboard including an upright member connected to the frame, the said inner moldboard having means slidably mounted on the upright member, a spring arranged to yieldably urge the inner moldboard in a downward direction, and a collar adjustably mounted on said upright member to limit downward movement of the inner moldboard.

29. A grader for maintaining the shoulder alongside a highway pavement comprising a traveling frame, a front moldboard connected to the frame for movemet over the shoulder and angled to throw graded earth toward the pavement, a rear moldboard connected to the frame and arranged to throw graded earth received from the front moldboard outwardly away from the pavement, an inner moldboard arranged to travel along the pavement and limit the inward flow of material from the front moldboard, and the said inner moldboard being supported for oscillating movements about a generally upright axis and having a tail portion extending outwardly adjacent the rear moldboard to contact the same and limit such movements in one direction.

30. In a grader, a moldboard operatively arranged at a working angle to move earth from a forward end toward and off its trailing end, the said moldboard being also operatively supported for upward movements at its trailing end with respect to its forward end, and a spreader member arranged upon the working side of the moldboard and sloping outwardly along said side in the direction of the trailing end whereby the accumulation of earth beneath the member will operate to raise the trailing end of the moldboard, and said spreader member having a trailing edge portion extending substantially at a right angle to the plane of the adjacent working side of the moldboard.

31. In a grader, a moldboard having a lower working edge and arranged at a working angle to move graded earth from its forward end toward its trailing end, the said moldboard being also operatively supported for up and down movements at its trailing end with respect to its forward end, a spreader plate arranged at the forward side of the moldboard and sloping outwardly therealong toward the trailing end and with the trailing edge portion of the plate ending substantially at the level of the working edge of the moldboard, and said plate having a part of its trailing edge portion extended forwardly of the moldboard and located at substantially the same level as the working edge thereof.

32. In a grader, a moldboard having a lower working edge and arranged at a working angle to move graded earth from its forward end toward its trailing end, the said moldboard being also operatively supported for up and down movements at its trailing end with respect to its forward end, a spreader plate arranged at the forward side of the moldboard and sloping outwardly therealong toward the trailing end and with the trailing edge portion of the plate ending substantially at the level of the working edge of the moldboard, and said plate having its said trailing edge portion extended substantially in horizontal alignment with the working edge of the moldboard.

LE GRAND H. LULL.