July 9, 1963 V. H. REISSER 3,096,696

MOTOR GRADER FRAME EXTENSION

Filed March 5, 1957 6 Sheets-Sheet 1

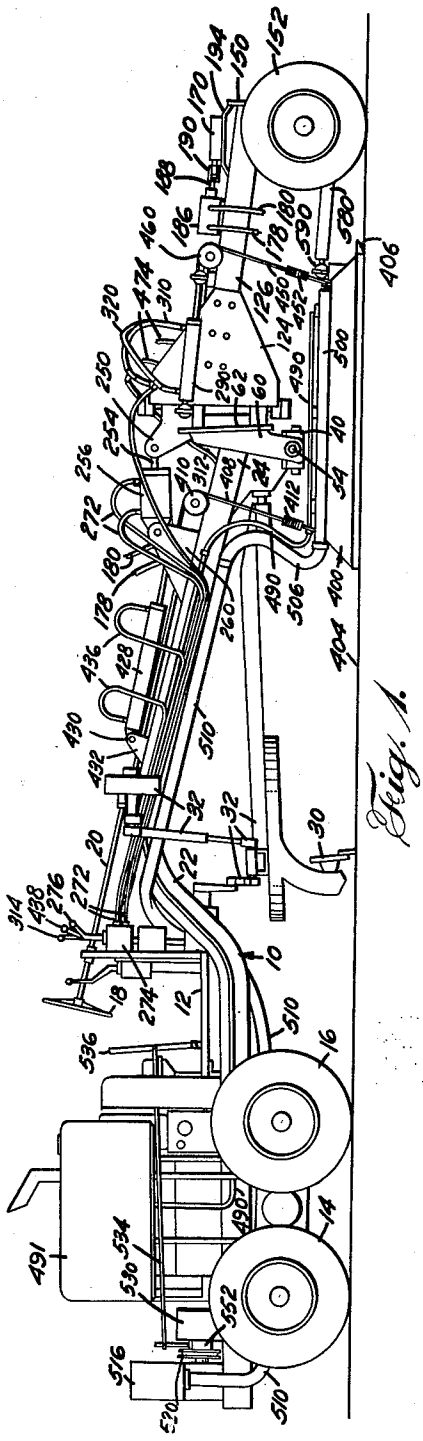


Fig. 1.

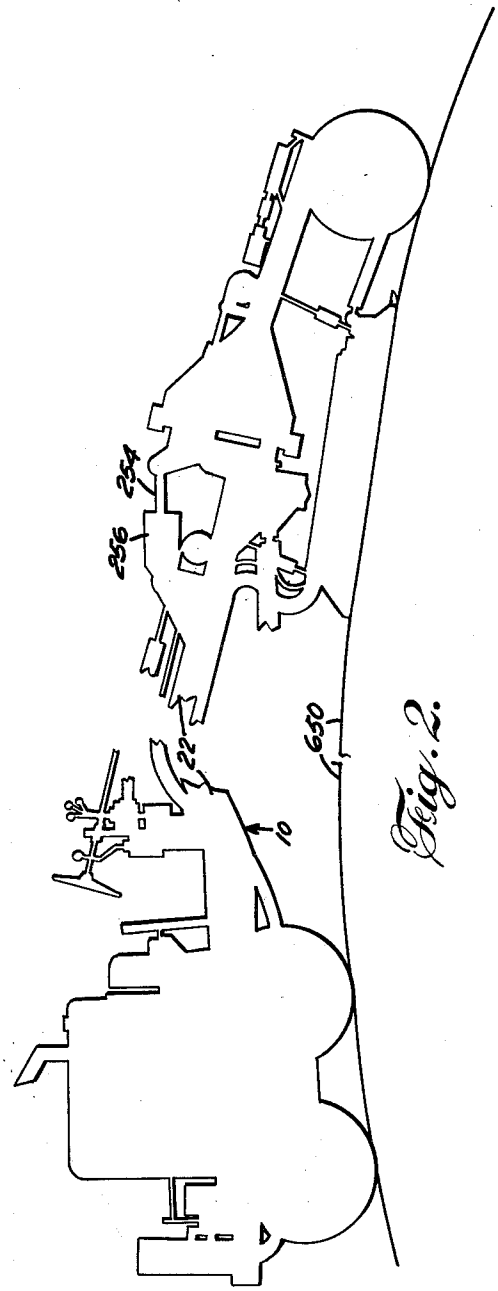


Fig. 2.

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MOTOR GRADER FRAME EXTENSION

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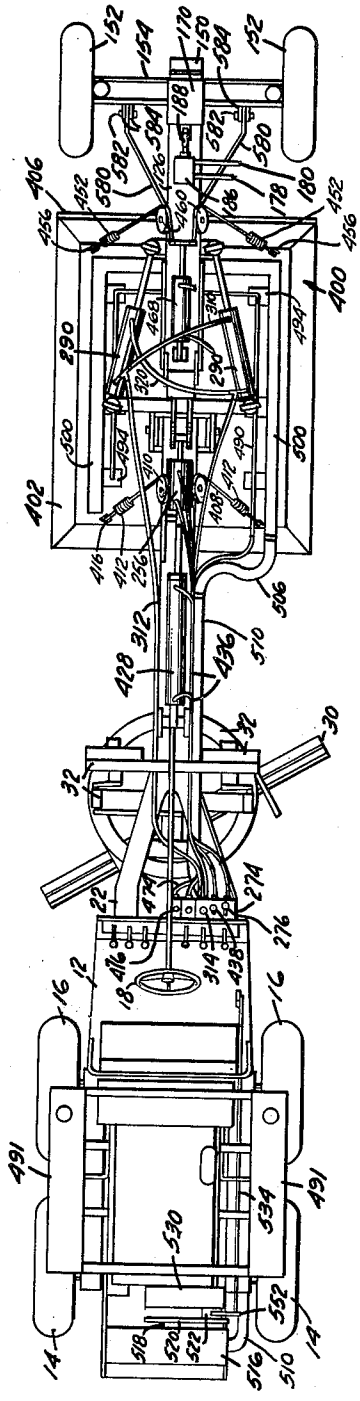


Fig. 3.

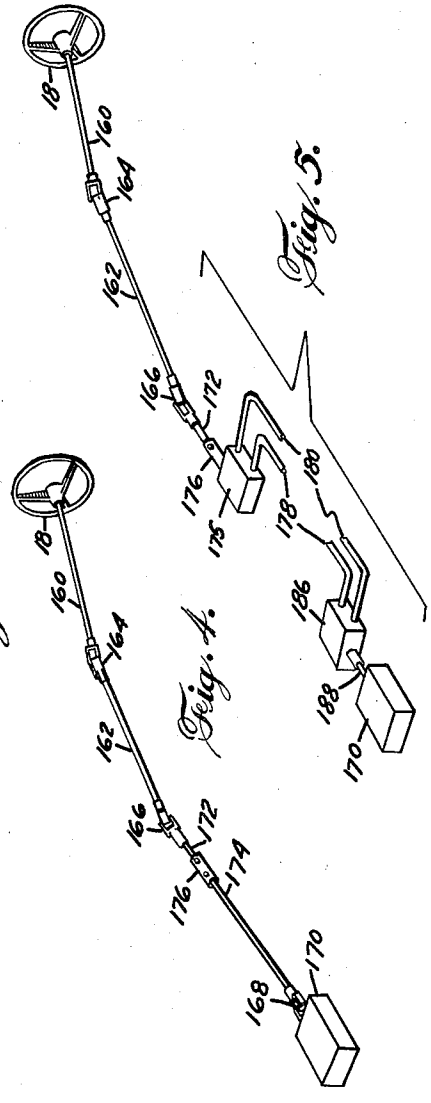


Fig. 4.

Fig. 5.

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MOTOR GRADER FRAME EXTENSION

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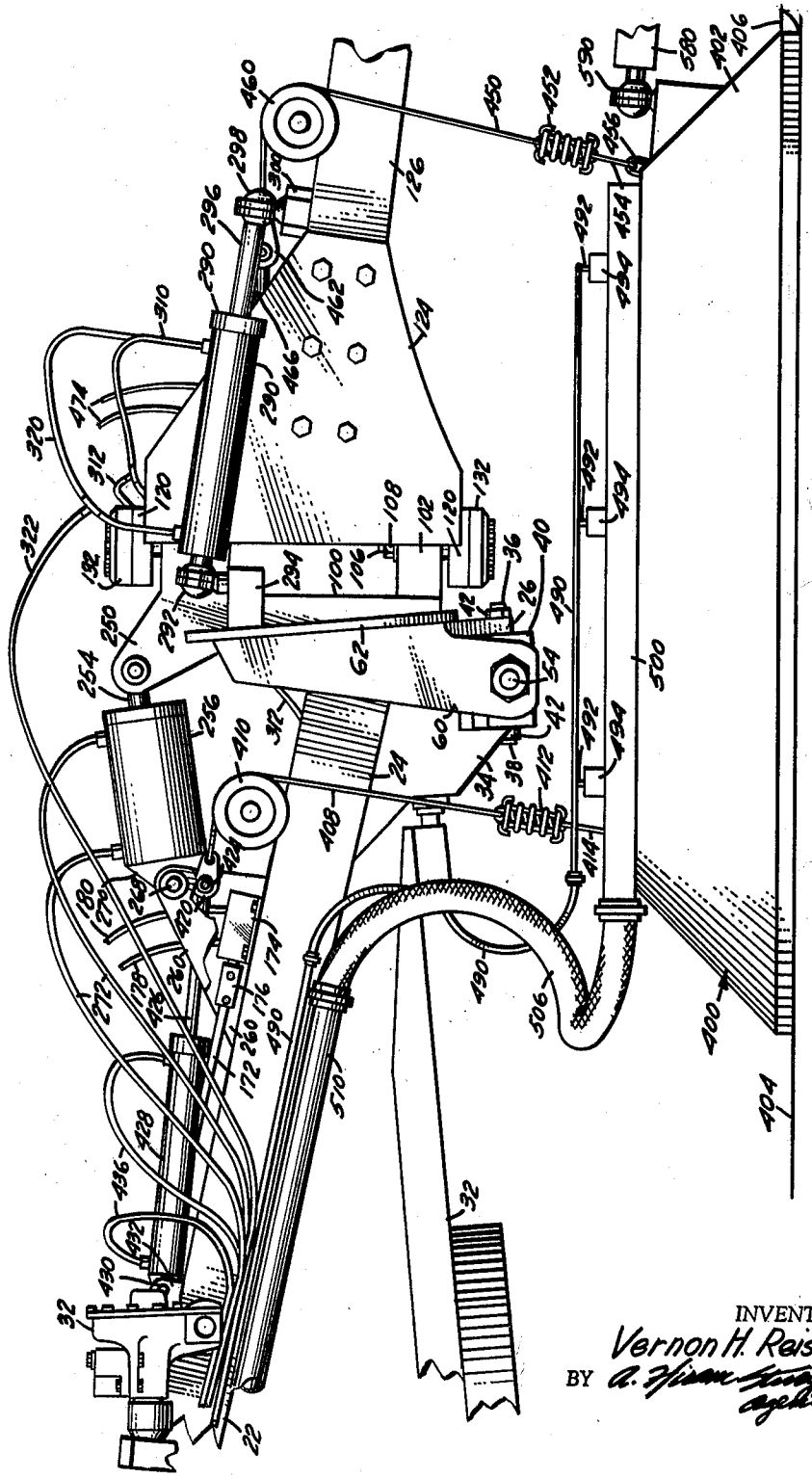


Fig. 6.

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MOTOR GRADER FRAME EXTENSION

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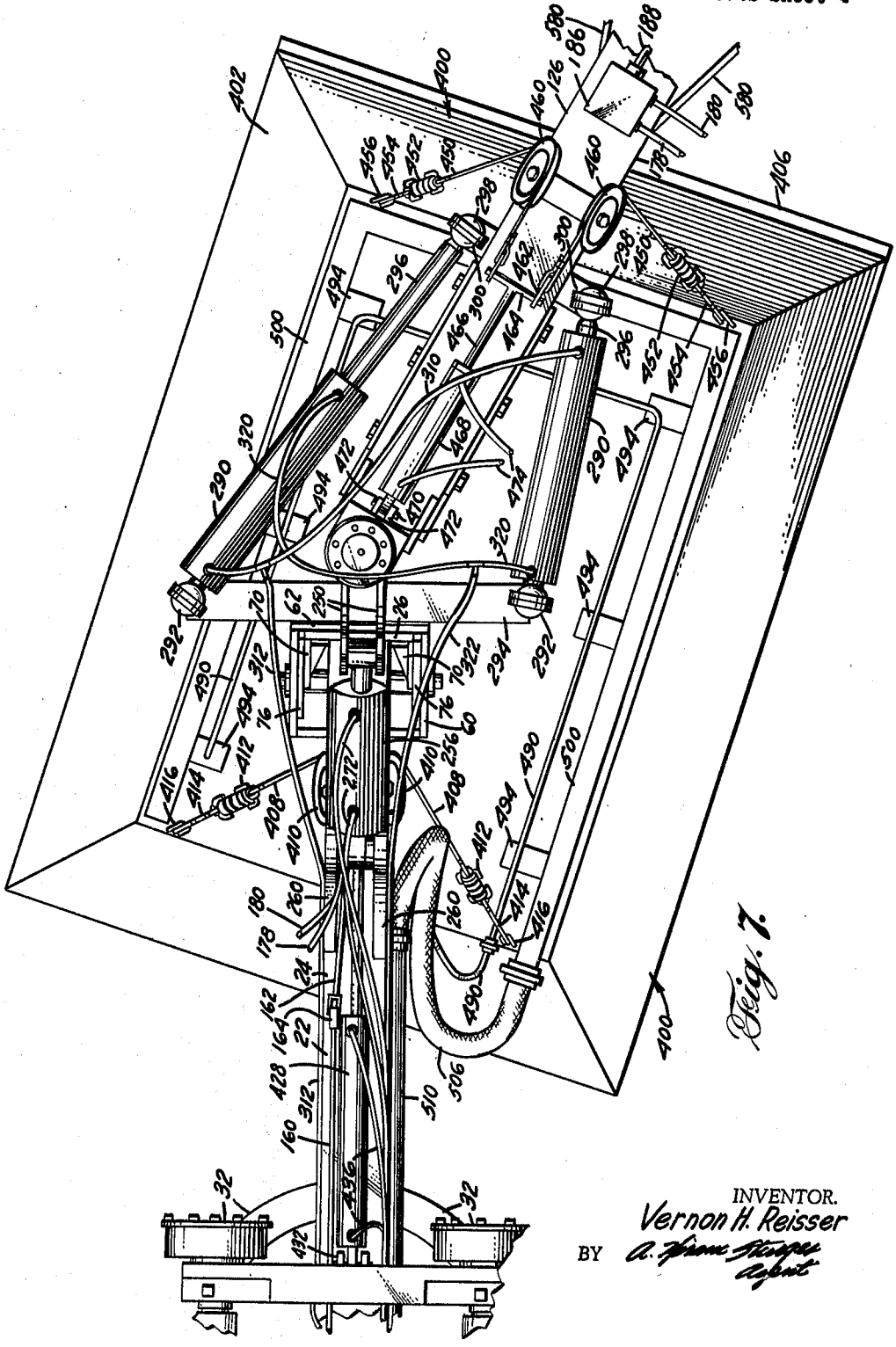


Fig. 7.

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MOTOR GRADER FRAME EXTENSION

Filed March 5, 1957 6 Sheets-Sheet 5

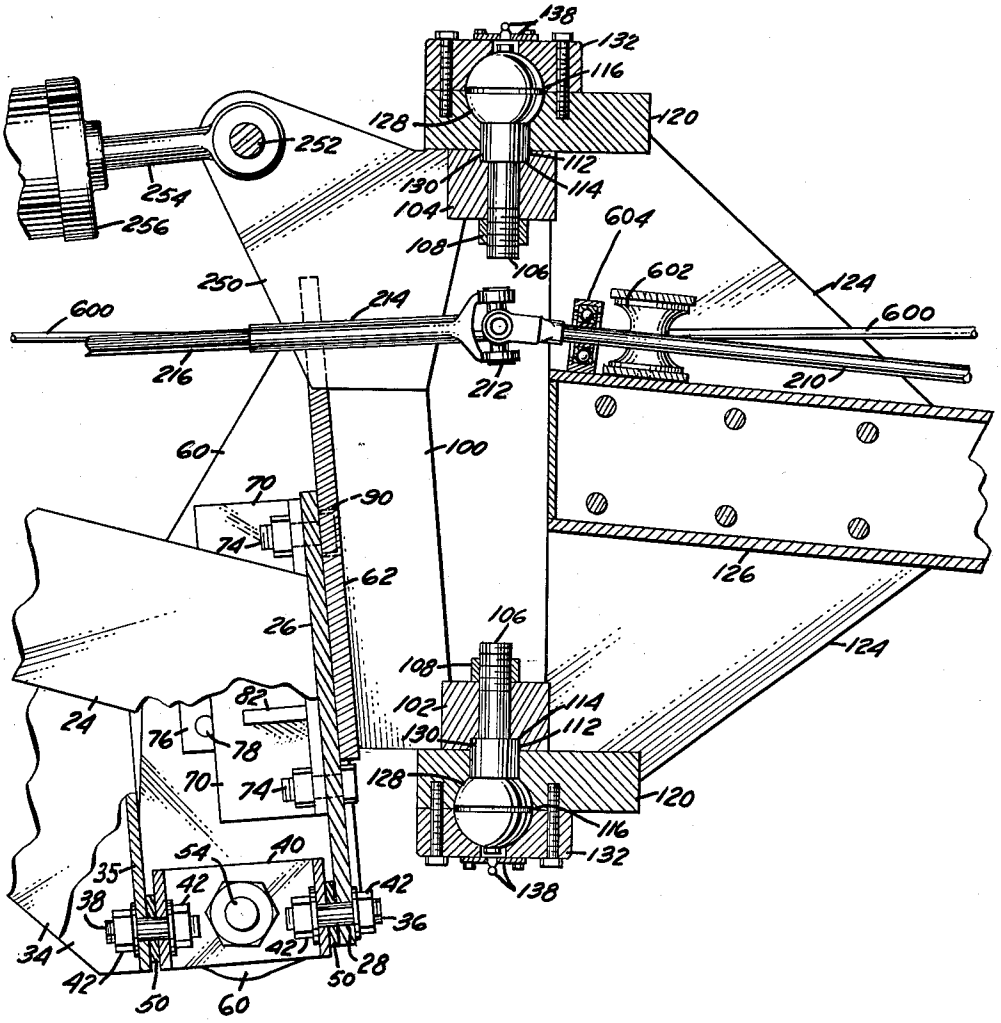


Fig. 8.

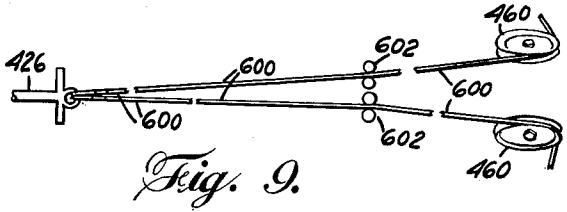


Fig. 9.

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MOTOR GRADER FRAME EXTENSION

Filed March 5, 1957 6 Sheets-Sheet 6

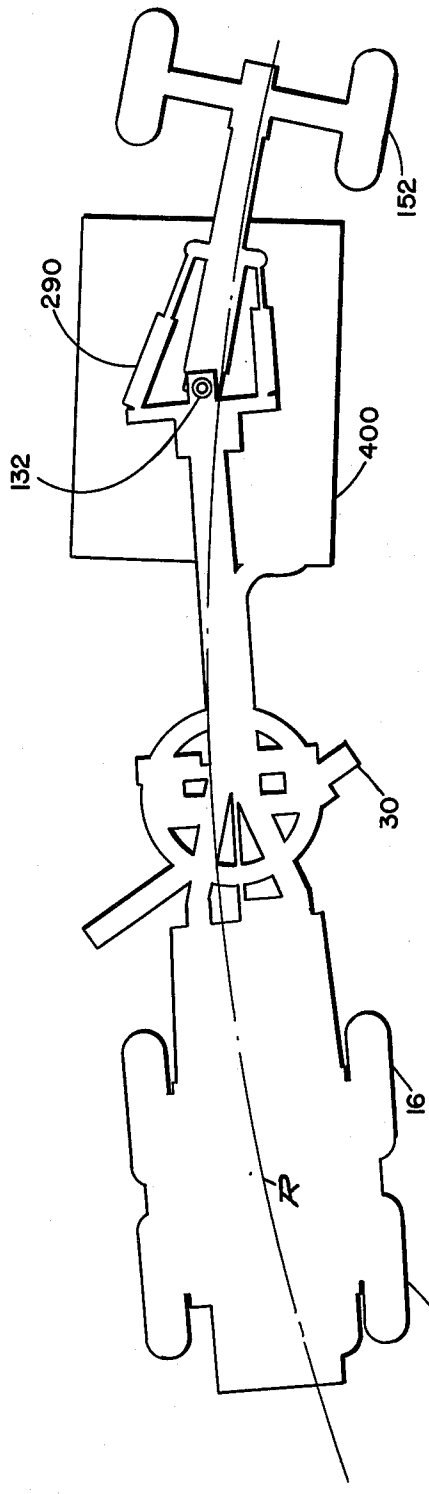


FIG. 10

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United States Patent Office 3,096,696 Patented July 9, 1963

3,096,696

MOTOR GRADER FRAME EXTENSION

Vernon H. Reisser, Omaha, Nebr.

Filed Mar. 5, 1957, Ser. No. 644,038
8 Claims. (Cl. 94—39)

This invention relates to road surface working machines and more particularly it is an object to provide in such a machine a frame with a mid-section bendable both with respect to the vertical or to the horizontal or both, with two surface working implements, one forward and one rearward of the place of bending.

A further object is to provide a machine as above in which the implements are each also controllable for vertical adjustment with respect to the frame.

This invention also relates to heater planers, the machines used primarily for removing irregular surfaces of asphalt roadway, and more particularly it is an object of this invention to provide a heater planer with a steerable frame which is adapted to pivot at a point between its ends whereby the heater which softens the asphalt, and the blade which cuts the asphalt, more closely follow the radius of the turn at times when the machine is turning whereby the blade follows the same path as the heater.

In heater planers of the prior art it has not been possible for the blade to follow in the same path as the heater when the machine is turning unless the width of cut made by the blade and the transverse dimension of the planer are otherwise than the ideal sizes desired. For travel on the public highways, it is most desirable that the heater be of a transverse width at its widest point substantially the same as the wheel base of the machine.

Because of this limitation in the desirable transverse width of the heater it has been necessary while turning to make a blade cut of a lesser width than is made during straightforward operations in order that the cut follow in the path of the heater.

It is therefore an object of this invention to eliminate this disadvantage of heater planers of the prior art by making it possible for a heater of substantially the width of the tread of the machine to form a heater path in the asphalt sufficiently wide that the cutting blade can make a cut during turning almost as wide as it makes in straightforward operation.

A further object of the invention is to provide a heater planer which will operate more efficiently around shorter corners because of the shorter turning radius of the machine, making possible a continuous forward operation around short corners.

A further object of the invention is to provide a heater planer, the frame of which is adapted to pivot in a manner making possible the vertical bending of the frame about the pivot point whereby the blade and oven, which are both attached to the frame, can be simultaneously vertically adjusted to more accurately adjust them to the contour of the surface being planed.

A further object of the invention is to provide a heater planer with which a more accurate cut can be maintained during operation because both ends of the blade are adjusted simultaneously by one master control whereby the operator can use the master control to adjust the blade pressure so that it is proportional to the traction of the drive wheels of the machine with greater ease than heretofore.

Heretofore mechanisms have been available for adjusting the vertical position of a blade in such a way that the ends of a blade are each raised and lowered equally. However, such mechanisms have had a cost of thousands of dollars and it is an object of this invention to accomplish this result by controllable arching of the frame.

A particular objective is to make it possible for the operator to gradually increase the arching of the frame as the machine approaches a ground surface which is of gradually increasing convexial curvature for gradually raising the blade to prevent undue depths of cutting, and also to make it possible for the operator to controllably lessen the arching of the frame.

It may be seen that a more accurate cut can be maintained during operation, because both ends of the blade can be adjusted simultaneously by one master control operating the hinging action of the frame, whereby the operator can use the master control to adjust the blade pressure so that it is proportional to the traction of the drive wheels of the machine and without changing the various adjustments of the angle of the blade and its lateral position with respect to the machine.

At times when it is desired to drive the machine through an area in which the roadway is concavously curved, it would be desirable to drop the blade beneath the wheels. This can be done by arching the frame before entering this area and the adjusting of the blade until the blade is in a desired position for travel on level ground. Then when the machine enters the area in which the ground is concave the operator can lower the frame at its hinged connections thereby lowering the blade below the wheels.

Other and further objects and advantages of the present invention will be apparent from the following detailed description, drawings and claims, the scope of the invention not being limited to the drawings themselves as the drawings are only for the purpose of illustrating a way in which the principles of this invention can be applied.

Other embodiments of the invention utilizing the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

A further object is to provide a heater planer from which a heater assembly can be quickly removed for the use of the machine as a motor grader alone, the motor grader having the advantage of greater accuracy of cut because of extended length.

In the drawings:

FIGURE 1 is a side elevation of a motor grader with the improvements of this invention attached thereto;

FIGURE 2 is a diagrammatic side elevation of the motor grader of FIGURE 1 with parts shown in positions they would assume when the motor grader is traveling over the top of a hill, certain parts being broken away;

FIGURE 3 is a top plan view of the invention as it would be seen looking from the top in FIGURE 1;

FIGURE 4 is a detail of the steering assembly commonly used on motor graders;

FIGURE 5 is a detail showing a modified steering assembly which could be used with this invention in substitution for the usual steering assembly of FIGURE 4;

FIGURE 6 is a side elevational detail of a central section of the assembly of FIGURE 1;

FIGURE 7 is a top plan view of the section of FIGURE 6 as it would be seen at times when the machine is turning a corner;

FIGURE 8 is a detail shown in cross section down the forward-to-rearward center of the machine in the area in which a frame extension of this invention is added to the motor grader frame; and

FIGURE 9 is a diagrammatic illustration of the modified heater adjusting cable arrangement described and illustrated in reference to FIGURE 8.

FIGURE 10 is a diagrammatic top view of the machine of this invention shown rounding a curve.

In the accompanying drawings, and in the following specification, the same reference characters are used to

designate the same parts and elements throughout, and in which the numeral **10** refers to the invention in its entirety, numeral **12** indicating a platform, such as that of a conventional grader, numerals **14** and **16** indicating wheels upon which the platform is supported, numeral **18** a steering wheel carried on the upper end of a steering wheel post or shaft **20**, and numeral **22** a frame having a leading end **24**.

The leading end **24** of the frame **22** is integrally connected to a plate **26** positioned transversely of the frame and the plate **26** is provided with a bolt hole **28** that is spaced from the lower edge.

A scraper blade **30**, also positioned transversely of the frame is supported by conventional elements **32** whereby the blade may be raised or lowered or set at different angles in vertical or horizontal planes.

The frame of the machine is provided with braces **34** that are integral with and connected to a plate **35** spaced rearwardly from the plate **26**, and the plate **35**, which is also transversely positioned, is connected to the plate **26** by bolts **36** and **38** and a box **40**, with nuts **42** on ends of the bolts **36** and **38** that extend into the box.

In accordance with this invention suitable bolts or stub axles **36** and **38** are disposed in the bolt holes **28** of the plates **26** and **35**, respectively and extend through the forward and rearward sides of the rectangular pivotal connection box **40** which latter has four substantially vertical walls arranged in a rectangle, and the connection box **40** is spaced from the plates **26** and **35** by suitable washers **50**.

The pivotal connection box **40** has pivot bolts **54** extending through the sides thereof on both the right and left and the bolts **54** are attached to hinge plates **60** which latter extend substantially vertically and pivot about the pivot bolts **54** to which they are connected by suitable nuts **62**.

The hinge plates **60** are adapted to swing forwardly and rearwardly about the pivot bolts **54** and are connected on their forward side to an upright substantially vertical transversely extending arresting plate **62** which latter is adapted to engage the forward plate **26** of the motor grader in order to arrest undesired excess rearward swinging motion of the hinge plates **60**.

In order to provide the hinge plates **60** with a true hinging action and to prevent them from moving to the right or left at their upper ends, suitable sway arresting members **70** are provided as best seen in FIGURE 8. The arresting members **70** are preferably of triangular shape in top plan view and have inwardly and transversely extending forward portions attached to the rearward side of the forward plate **26** of the motor grader by suitable bolts **74**. Each sway arresting member **70** has a rearwardly extending portion which is disposed vertically and which presents a flat surface extending forwardly and rearwardly along the inner side of the hinge plate **60**.

Considerable wear would come between the sway arresting members **70** and the hinge plates **60** and for this reason a suitable wear plate **76** is attached to the inner side of each of the two hinge plates **60** by means of suitable bolts **78**, which, as best seen in FIGURE 8, are imbedded in the wear plates **76**.

The sway arresting member **70** is strengthened by suitable webs **82**, one of which can be seen in FIGURE 8.

The arresting plate **62** is provided with openings therein, as best seen at **90**, for receiving the heads of the bolts **74** in order that the arresting plate **62** can fit directly against the forward side of the forward plate **26** of the motor grader.

Referring to FIGURE 8 it will be seen that two vertical connecting members **100** are attached to the forward side of the arresting plate **62**. The connecting members **100** are attached at their lower ends to a block **102** and at their upper end to a similar block **104**. The blocks **102** and **104** have bolts **106** mounted therethrough and rigidly secured thereto by means of nuts **108** drawing the bolts inwardly. The bolts **106** have shoulders **112** on the opposite side of the respective blocks **102** and **104** and received in recesses **114** in the blocks **102** and **104**. As thus described the bolts **106** are rigidly secured in the blocks **102** and **104** for firmly supporting balls **116** at the outer ends of the bolts **106** respectively.

The bolts **106** are in alignment providing a trunnion connection between the main frame and front frame section.

Two further blocks **120** are disposed above and below the blocks **102** and **104** and the blocks **120** are secured by fishplates **124** to a frame extension **126** of this invention and later described.

The blocks **120** receive the balls **116** in suitable recesses **128** in their upper and lower sides respectively, as best seen in FIGURE 8.

The blocks **120** also have openings **130** therethrough of a size for rotatably receiving the shoulders **112**.

Lubrication is maintained at the balls **116** by providing them with cap members **132** which are bolted to the block members **120**, the cap members **132** having fittings **138** for convenient greasing.

Referring to FIGURE 1 it will be seen that the frame extension **126** extends forwardly a considerable distance and terminates in an extension forward plate **150** attached transversely of the frame extension **126**. Forward wheels **152** are disposed under the forward end of the frame extension **126** and the latter are mounted on an axle **154**, the wheels **152** and the axle **154** being old and conventional in the art and being the axle and wheels normally disposed at the forward end of the motor grader **10** and which have been removed therefrom.

The axle **154** is connected to the frame **126** in any suitable manner and preferably in ways customary in motor graders and for that reason the connection is not described in detail here. However it is customary that the axle **154** will be free to pivot about its center and upwardly and downwardly at either side.

Referring to FIGURE 4, it will be seen that the usual way of steering a motor grader is with a steering wheel **18** connected to a shafting **160** which is itself connected to a shafting **162** by universal joint **164**. The shaftings **160** and **162** extend forwardly and rearwardly, and the forward shafting **162** is connected by a universal joint **166**. The joint **166** is ordinarily connected by a shaft, not shown, to a universal joint **168** which is itself connected to a power steering unit **170**.

In accordance with this invention, however, the shafting which is not shown is removed, and in its place are substituted two shaft sections **172** and **174** interconnected by a removable coupling **176**.

Referring to FIGURE 5 a modification of the steering arrangement of the conventional motor grader is there shown which is one modification which could be used with this invention. In FIGURE 5 the steering wheel is shown at **18** and the shafts **160** and **162** are the same and are interconnected by the universal joint **164**. The same universal joint **166** is used, and to the forward end of the shaft **172** an hydraulic motion transfer unit **175** is attached by a coupler **176**. The motion transfer unit **175** is connected by two hydraulic lines **178** and **180** to a second motion transfer unit **186**. The latter is connected to a shaft **188** which is in turn connected to a power steering unit **170**.

It will be understood that the power transfer units **175** and **186** can be of any conventional and suitable construction whereby at times when the steering wheel **18** is turned in one direction, such as in a clockwise direction, as shown in FIGURE 10, a flow of hydraulic fluid forwardly in the line **178** occurs and a flow of hydraulic fluid rearwardly in line **180** simultaneously occurs. This causes the second power transfer unit **186** to initiate a corresponding rotation in the shaft **188**. When the steering wheel **18** is rotated in the opposite direction the flow

of fluid in the lines 178 and 180 is reversed and the rotation of the shaft 188 is reversed.

The purpose of the steering arrangement of FIGURE 5 can now be seen by referring to FIGURE 1 in which the power transfer unit 186 is seen directly behind the power steering unit 170 with the two connected by the shaft 188 and a universal joint 190.

The hydraulic steering unit 170 is mounted on a bracket 194 on the forward end of the frame extension 126 and it is understood that the power transfer unit 170 is connected to the wheels 152 in a usual and conventional way for the steering of the wheels 152 by means not here shown. In this respect it will be seen that the forward end of the frame extension 126, the power transfer unit 170, the wheels 152, and associated parts are identical in position and operation to the way in which they would operate if the forward end of the extension 126 were instead the forward end 24 of the frame member 22 of the standard motor grader.

Referring now to FIGURE 7 and at the righthand side thereof, the motion transfer unit 174 is there shown and it will be understood that the hydraulic lines 170 and 180 extend forwardly to the other motion transfer unit 186.

However referring to FIGURE 8, a preferred form of a steering arrangement is shown which is a modification of a motor grader steering arrangement of FIGURE 4. In FIGURE 8 a shaft is seen at 210 which is in substitution for the shaft 172 of FIGURE 4. The shaft 172 is much shorter than the shaft 210 and it will be understood that the steering arrangement of FIGURE 8 has a long shaft 210 sufficiently long to reach the universal joint 168 of FIGURE 4 even when the power steering unit 170 is placed on the extreme forward end of the frame extension end 126 of this invention.

The shaft 210 is connected by a universal joint 212 to a sleeve 214. The sleeve 214 receives the forward end of a shaft 216 in a manner whereby the shaft 216, which is preferably rectangular or non-round, can telescope with respect to the sleeve 214 but cannot rotate with respect to the sleeve 214 which latter has an elongated opening therethrough shaped in cross section correspondingly to the shaft 216. The rearward end of the shaft 210 is journaled in a bearing 604 which latter is mounted on the frame extension 126.

It will be seen that when the shaft 210 is substituted for the shaft 172, and the universal joint 212 for the universal joint 166 of the standard motor grader, and the shaft 216 for the shaft 162 of the standard motor grader, then steering in a usual way can be done provided the universal joint 212 is directly in line with the balls 116 supporting the forward portion of the frame as added by this invention.

Referring to FIGURE 8, it will be seen that the members 100 have upper ends 250 attached thereto and which are also spaced apart and which extend a short distance rearwardly, receiving therethrough a pin 252 which pivotally attaches the upper ends 250 to the shaft 254 of a vertical control hydraulic cylinder 256.

The vertical control cylinder 256 is pivotally mounted between two mounting plates 260 which are spaced apart and which extend downwardly to and are rigidly secured to the forward end 24 of the frame member 22. The two connection plates 260 are attached by a bolt 268 to a member 270 which is fixed to the rearward side of the cylinder 256 for permitting the cylinder 256 to swing upwardly and downwardly at its forward end about the horizontal pin 268.

Vertical hinging control hoses 272 are connected to the cylinder 256 and extend rearwardly to a hydraulic fluid control unit 274 mounted adjacent the steering wheel 18 and controlled by a lever 276.

It is desired that the frame extension 126 be steerable in the sense that it can be swung to the right or to the left at its forward end about the pivot axis provided by the two balls 16.

To control this swinging to the right and left, right and left horizontal turning control cylinders 290 are provided on each side of the frame extension 126 and connected at their rearward ends by ball and socket joints 292 to the outer end of a transverse support member 294 which latter is rigidly secured to the forward side of the arresting plate 62.

The hydraulic turning control cylinders 290 are so arranged that the forward ends of their shafts 296 incline considerably inwardly toward ball and socket connection joints 298 to which they are attached, the joints 298 being mounted on a transverse supporting member 300 which is attached to the upper side of the frame extension 126.

A hose 310 connects the forward end of the right hand cylinder 290 with the rearward end of the lefthand cylinder 290 and the hose 310 is connected to a control hose 312 which extends rearwardly to the control unit 274 having a lever 314 adjacent the steering wheel 18.

Another hydraulic hose 320 connects the rearward side of the right cylinder 290 with the forward side of the left cylinder 290 and is itself connected to a control hose 322 which extends rearwardly to the same hydraulic control unit as the line 312 and is also controlled by the lever 314.

It will be seen that the frame extension 126 of this invention is adapted for many uses, one of which is the application of a heater beneath the frame at the point of connection between the motor grader frame and the frame extension.

In this way the heater can work in cooperation with the blade 30 to make a more highly effective heater planer.

Referring to FIGURES 1 and 7, the heater assembly is generally indicated at 400 and comprises a hood 402 which is disposed very close to the surface 404 of the roadway, a skid member 406 being provided at its forward end to allow the assembly to ride over irregular surfaces.

As best seen in FIGURE 7 the heater cover 402 is suspended from the forward end 24 of the frame 22 by cables 408 which extend downwardly from the forward sides of right and left pulleys 410 rotatably mounted on opposite sides of the forward end 24 of the frame member 22 by suitable means. The pulleys 410 are approximately vertically disposed but preferably incline outwardly at their lower ends to a limited extent. The cables 408 are each attached to spring assemblies 412 which are in turn attached to hooks 414 which are removably connected to other hooks 416 which are fixed to the cover 402.

The cables 408 extend rearwardly from the pulleys 410 at their upper ends and are attached by link members 420 to a transverse member 424 arranged transversely of a shaft 426 of a cylinder 428 which latter is forwardly and rearwardly disposed behind the pulleys 410.

The rearward end of the cylinder 428 is pivotally attached at 430 to suitable connecting ears 432 which are anchored to the frame member 22 on its upper side.

Hydraulic lines 436 extend rearwardly from the cylinder 428 to the hydraulic control unit 274 and is controlled by a lever 438 within easy reach of the driver.

The forward end of the cover 402 is suspended on cables 450 which are attached to similar spring assemblies 452 as are in turn attached to hooks 454, which latter are attached to other hooks 456 anchored to the cover 400. The cables 450 are disposed over pulleys 460 which are suitably mounted on the top of the frame extension 126.

The pulleys 460 are also disposed approximately vertical or preferably inclined outwardly at their lower ends to some extent. The cables 450 extend over the pulleys 460 and then are attached by connection members 462 to a transverse member 464 which extends transversely to and is attached to a shaft 466 of a cylinder 468 which latter is disposed extending forwardly and rearwardly above the frame extension 126.

The rearward end of the cylinder 468 is pivotally

anchored to the frame member 126 by a pivot bolt 470 and extends horizontally and transversely of the cylinder 468, the bolt 470 being supported in ears 472 attached to the frame member 126.

The cylinder 468 is controlled by two hydraulic lines 474 which extend rearwardly. The hydraulic lines 474 are shown broken away for convenience of illustration, but it will be understood that they are attached to the hydraulic control unit 274 and are controlled by the lever 476.

The heater assembly 400 receives fuel through a fuel line 490, best seen in FIGURE 7. The line 490 extends around the two sides in the forward end of the cover 402, and as best seen in FIGURE 6, the line 490 is connected by short lines 492 to fuel injection and ignition assemblies 494 of any conventional construction.

The fuel line 490 extends rearwardly and may be seen extending along the right side of the frame member 22 and being attached to a fuel tank 491 mounted on the motor grader on any suitable point, preferably alongside the engine.

Air is blown into the heater assembly 400 through an air duct 500, as best seen in FIGURE 6, and of any conventional construction. The duct 500 is disposed above the cover 402 and is attached thereto and extends around the sides and the forward end of the cover 402 with suitable delivery ports for delivering air into the cover 402. The duct 500 receives air from the hose 506 which is connected to a pipe 510 which extends rearwardly along the frame member 22, as best seen in FIGURE 1, and extends along the bottom of the rearward end of the motor grader and can be seen again behind the rear wheel of the motor grader extending up to a blower 516.

The blower 516 receives its power through a shaft 518 driven by a pulley and belt assembly 520 which latter receives power from a pulley and clutch assembly 522. The pulley and clutch assembly 522 is connected by a housed belt and pulley assembly 530 to the standard take-off shaft, not shown, at the rearward end of the motor grader.

The clutch assembly 522 is controlled by an arm 532 actuated by a rod 534 as is controlled by a lever 536 disposed adjacent to the steering wheel 18 and within convenient reach of the driver.

The lever 536 is pivoted about its lower end, and can be moved forwardly and rearwardly to control the clutch assembly 522 to deliver power to the blower 516 when desired.

As best seen in FIGURE 3 it will be seen that two towing members 580 extend rearwardly and inwardly from point adjacent the outer ends of the axle 154 to which they are pivotally attached by means of bolts 582 and ears 584 whereby the towing members 580 are adapted to pivot about an axis in parallelism with the axle 154 and disposed directly behind the axle 154.

At their rearward ends the towing members converge to a point under the center of the frame member 126 and are there connected to a ball and socket joint 590 which is in turn attached to the forward side of and at the transverse center of the heater assembly 400. In this way the towing members 580 tow the heater assembly 400 along.

Referring to FIGURE 8, a modification of the arrangement of the other views for raising the forward heater assemblies supporting cables 450 is there shown. In the modification of FIGURE 8 a left cable 600 passes through the upper fishplates 124 and across the top of the frame extension 126 and is disposed between the two left pulleys of a pulley assembly 602 which latter holds the cable 600 in place. A similar cable and pulleys, not shown, are used on the right hand side.

The left cable 600 and the right cable, not shown, both extend rearwardly to the center of the transverse member 424 on the shaft 426 of the cylinder 428. This connection with the shaft 424 is not shown in FIGURE 8. At their forward ends the left cable 600 and right cable, not shown, are attached to the rearward ends of the respective cables 450 in place of the transverse member 464 of the shaft 466 of the cylinder 468. As thus described it will be seen that the cylinder 428 can lift both the forward suspension cables 450 and the rearward suspension cables 412 simultaneously whereby with the modification shown in FIGURE 8, the cylinder 468, its shaft 466, and the transverse member 464 are all unnecessary.

The modification of FIGURE 8 has the advantage that the driver in manipulating the lever for only one cylinder, namely the cylinder 428, thus simultaneously controls the cables at both the forward and rearward ends of the heater assembly.

In operation of the machine, it will be seen that the operator can manipulate the lever 276 for actuating the vertical control cylinder 256 which causes the hinging and raising of the forward end of the frame member 22 and rearward end of the frame extension 126. This will have the effect of arching the machine and providing more clearance between the surface of the ground and the lowermost points of the center part of the machine which are the lower ends of the hinge plates 60.

The advantage of this arching of the frame can be seen in FIGURE 2 in which the ground surface is upwardly curved as shown at 650 as it would be when the machine is passing over the top of the hill. In the position shown in FIGURE 2 it will be seen that the shaft 254 of the vertical hinging control cylinder 256 is extended a greater distance than it is in FIGURE 1. This raises the lowermost ends of the hinge plates 60 up away from the ground a greater distance for permitting the heater assembly 400 to be received between the convex ground surface of the hill and the lower ends of the hinge plates 60.

It can be further seen that the operator can provide the machine with a sharper turning radius by manipulating the lever 314 for actuating the right and left horizontal turning control cylinders 290 to cause the forward frame extension 126 to turn to the right or the left at its forward end. This turning reduces the turning radius of the vehicle by adding to the amount of turning that can be done by the turning of the forward wheels 152 themselves.

The shorter turning radius thus accomplished is of great advantage in places where short turning radius is desirable. In addition it will be seen that the turning of the frame extension 126 has a tendency to cause the cover 402 of the heater assembly 400 to assume a position considerably inclined to the right or the left as the case may be with respect to the motor grader itself. The cover 402 will incline to the right at its forward end when the frame extension 126 is inclined to the right at its forward end for example.

It will be seen that the rearward end of the cover 402 of the heater is adapted to swing outwardly and to the opposite side of the motor grader from that side of the motor grader to which the forward end of the frame extension 126 is swung, as is made possible because the cables 408 supporting the rearward end of the cover 402 permit this swinging of the rearward end of the cover 402 and the turning of the extension will cause this outward swinging.

It is important that the cover 402 of the heater planer be swung out with respect to the motor grader for the reason that the total transverse width of a heated swath of the heater assembly 400 will be greater than would be if the heater assembly 400 were direcly parallel with the motor grader.

The greater swath of the heater assembly 400 is matched by the width of cut of the planer or scraper blade 30 whereby the width of the road resurfacing work done by heating and planing with the machine is almost as great on corners as on a straight-forward travel.

It will be seen that other implements for working the surface over which the machine is traveling could be used in place of the heater assembly 400 and could be suitably

connected to the extension **126** and/or to the motor grader **10** to serve other purposes and that in such other uses the shorter turning radius made possible by this invention and the arching of the frame made possible by this invention would be very useful.

It will be further seen that the extension **126** has the effect of making a motor grader of longer wheel base. This longer wheel base allows the blade **30** to grade the road more evenly than would be the case with a motor grader of normal length. It will be seen that the frame as a whole is bendable with respect to a vertical and with respect to a horizontal plane through the bending place giving new adjustment possibilities and extra value in using two surface working implements.

In FIGURE 10 is a diagrammatic top view of the machine shown in a position rounding a curve with the general path of the machine being indicated by a dotted line "R." If the machine were as flexible as a snake its transverse center at all points would be in the position of the dotted line "R." However, as the pivoting visible in the top plan view is about a vertical axis at the cap member **132** this construction of machine makes it possible for the heater assembly generally indicated at **400** to be disposed with the center of its area much closer to the arc of turning "R" than would be possible without the bending of the form about a vertical axis.

The machine thus described is believed to fulfill the objects above set forth.

From the foregoing description, it is thought to be obvious that a motor grader frame extension constructed in accordance with my invention is particularly well adapted for use, by reason of the convenience and facility with which it may be assembled and operated, and it will also be obvious that my invention is susceptible of some change and modification without departing from the principles and spirit thereof, and for this reason I do not wish to be understood as limiting myself to the precise arrangement and formation of the several parts herein shown in carrying out my invention in practice, except as claimed.

I claim:

1. In a grader, the combination which comprises an elongated frame including a plurality of pivotally connected leading and trailing frame sections, wheels upon which the leading end of the leading section of the frame is mounted, a first implement carried by a pair of said pivotally connected adjacent sections of the frame, a second implement carried by a trailing section of the frame, means pivotally connecting the section at the leading end of the frame to the leading end of the trailing section of the frame for pivoting of these sections about both a vertical and a horizontal axis, and controllable means for swinging the said leading section about said vertical and horizontal axes.

2. In a grader, the combination which comprises an elongated frame including a plurality of pivotally connected leading and trailing frame sections, wheels upon which the frame section at the front of the grader is supported, a heater suspended from sections of the frame and positioned in spaced relation to a surface upon which the grader is positioned, a scraper blade mounted on the trailing frame section and positioned to follow the heater, means pivotally connecting the frame section at the leading end of the frame to the trailing section on a vertical axis, positioned substantially midway of the length of the heater, and spaced rearwardly from the wheels of the front frame section means pivotally connecting the sections of the frame on a horizontal axis, also spaced rearwardly of the wheels of said front frame section power steering means on a section at the forward end of the frame for actuating wheels at the leading end of the frame for steering the grader, and hydraulic cylinder and piston units mounted on the frame sections and operatively connected to the heater and scraper blade for supporting and adjusting the heater and scraper blade from the trailing end of the frame.

3. In a planer, the combination which comprises an elongated frame including a plurality of pivotally connected leading and trailing frame sections, front wheels upon which the leading end of the front frame section is supported, a tractor upon which the trailing end of the frame is supported, a heater spaced rearwardly from said front wheels, a scraper blade suspended from the trailing section of the frame and spaced rearwardly of the heater, hydraulic piston and cylinder units mounted on adjacent frame sections and connected by cables to opposite ends of the heater for supporting and raising and lowering the heater, a transverse support member mounted on a leading end of a trailing section of the frame and positioned to the rear of the center of the heater, hydraulic piston and cylinder unit mounted on said transverse support member and having piston rods connected to the sides of said front frame section, and hydraulic piston and cylinder steering means operatively connected to said front wheels.

4. In a road surfacing machine, the combination which comprises an elongated frame including pivotally connected leading and trailing frame sections, front wheels upon which the section at the leading end of the frame is supported, rear wheels upon which the section at the trailing end of the frame is supported, a scraper suspended from the frame section at the trailing end of the machine and positioned forwardly of said rear wheels, a heater including an inverted hood positioned between the front wheels and scraper, cables extended upwardly from leading and trailing ends of the hood, pulleys on sections of the frame and over which the cables are trained, hydraulic cylinders mounted on adjacent sections of the frame and having piston rods connected to the cables for adjusting the elevation of the hood, the sections of the frame being pivotally connected on a vertical axis to permit the leading section to swing laterally and said vertical axis being positioned substantially midway of the length of the hood, said sections of the frame being also connected on a horizontal axis to permit the sections to swing vertically, a hydraulic cylinder and piston unit mounted on one of said sections and positioned with the piston rod connected to the other of said sections for adjusting the angular positions of said sections in horizontal planes, power steering means operatively connected to the front wheels of the frame, and controllable means for causing said forward section to swing with respect to said rearward section about said horizontal axis.

5. In a road planer machine, the combination which comprises an elongated frame including pivotally connected leading and trailing frame sections, front wheels mounted on the section at the leading end of the forward frame section for supporting the forward end of the frame, rear wheels mounted on the section at the trailing end of the trailing frame section for supporting the trailing end of the frame, an inverted hood suspended by cables from the frame and spaced rearwardly from said front wheels, cylinders mounted on adjacent sections of the frame and having piston rods to which the cables are connected whereby the hood is raised and lowered by the cylinders, a burner positioned in the hood, a transversely disposed scraper suspended from the said trailing section and positioned to follow the hood, said frame sections being connected on a vertical axis and said vertical axis being positioned substantially midway of the length of the hood, a transverse support member mounted on the leading end of the trailing frame section and pivotally connected to the forward frame section on the vertical axis, hydraulic cylinders pivotally connected to transverse ends of the transverse support member and having piston rods extended on each side of said vertical axis and pivotally connected to sides of said forward section, means adjacent said vertical axis pivotally connecting said sections of the frame on a transverse horizontal axis, a hydraulic piston and cylinder unit extending intermediate and pivotally connected to said forward and trailing frame sections, said hydraulic unit being disposed substantially perpendicular to said transverse hori-

zontal axis, and a power steering unit operatively connected to said front wheels for steering the planer machine.

6. In an asphalt softener and scraper, the combination which comprises a tractor, a longitudinally disposed main frame extended forwardly from the tractor, a front frame section pivotally connected to the leading end of said main frame by vertically aligned trunnion elements, ground engaging wheels rotatably mounted on said front frame section, a heater hood suspended from the main frame and front frame section, cables extended from the forward end of the hood to a hydraulic cylinder and piston unit mounted on said front frame section for adjusting the elevation of the forward end of the hood, cables extended from the trailing end of the hood to a hydraulic cylinder and piston unit on the main frame for adjusting the elevation of the trailing end of the hood, hydraulic cylinder and piston units mounted on opposite sides of the main frame and connected to opposite sides of the front frame section for swinging the front frame section laterally about the axis of the trunnions for negotiating a turn, a scraper positioned below the intermediate portion of the main frame, and means for supporting and adjusting the scraper from the main frame.

7. In an asphalt softener and scraper, the combination which comprises a vehicle, a longitudinally disposed main frame extended forwardly from the vehicle, a front frame extended forwardly from the leading end of the main frame, vertically aligned trunnion elements connecting the front frame to the main frame, said trunnion elements arranged for lateral swinging of said front frame, ground engaging wheels rotatably mounted on said front frame, hinge plates positioned on the leading end of the main frame and trunnion elements on the trailing end of the front frame, pivot bolts, the axes of which are horizontally disposed, pivotally connecting the hinge plates whereby the frame sections are free to swing in vertically disposed planes, a heater hood positioned below the frames, cables extended from the forward end of the heater hood to a hydraulic cylinder and piston assembly mounted on the front frame, cables extended from the trailing end of the heater hood to a hydraulic cylinder and piston assembly on the main frame, hydraulic cylinder and piston assemblies mounted on opposite sides of the main frame and having piston rods extended therefrom and operatively connected to opposite sides of said front frame, a scraper blade positioned to follow the heater hood and said heater hood being spaced rearwardly of the ground engaging wheels, and means mounted on the main frame for supporting and adjusting the scraper blade.

8. In an asphalt softener and scraper, the combination which comprises a power actuated vehicle, a longitudinally disposed main frame supported by and extended forwardly from the vehicle, a front frame extended forwardly from the leading end of the main frame, supporting wheels on the forward end of said front frame, a heater hood suspended below the frames and spaced rearwardly of said wheels, a scraper suspended below the main frame and positioned to follow the hood, means pivotally connecting the front frame to the forward end of the main frame on a vertical axis whereby the front frame is mounted to swing laterally, means pivotally connecting the front frame to the main frame on a horizontal axis whereby the front frame is mounted to swing vertically, a hydraulic cylinder and piston assembly mounted on the front frame and connected by cables to the forward end of the hood for adjusting the elevation of the forward end of the hood, a hydraulic cylinder and piston assembly mounted on the main frame and connected by cables to the trailing end of the hood for adjusting the elevation of the trailing end of the hood, a transverse supporting member positioned on the forward end of the main frame, hydraulic cylinder and piston assemblies mounted on said transverse supporting member and connected to opposite sides of said front frame for actuating the front frame laterally, a hydraulic cylinder and piston assembly mounted on the main frame and connected to the front frame for swinging the front frame vertically, and means for supporting and adjusting the scraper.

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