Jan. 15, 1957 G. S. ALLIN, JR 2,777,222

MOLDBOARD TILT COMPENSATION ARRANGEMENT

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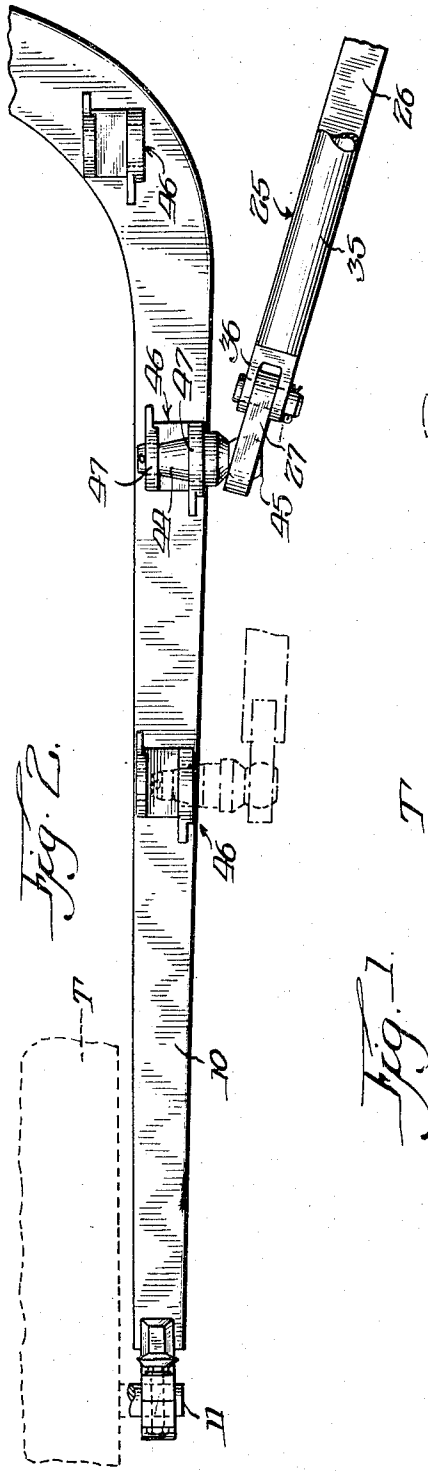


Fig. 2.

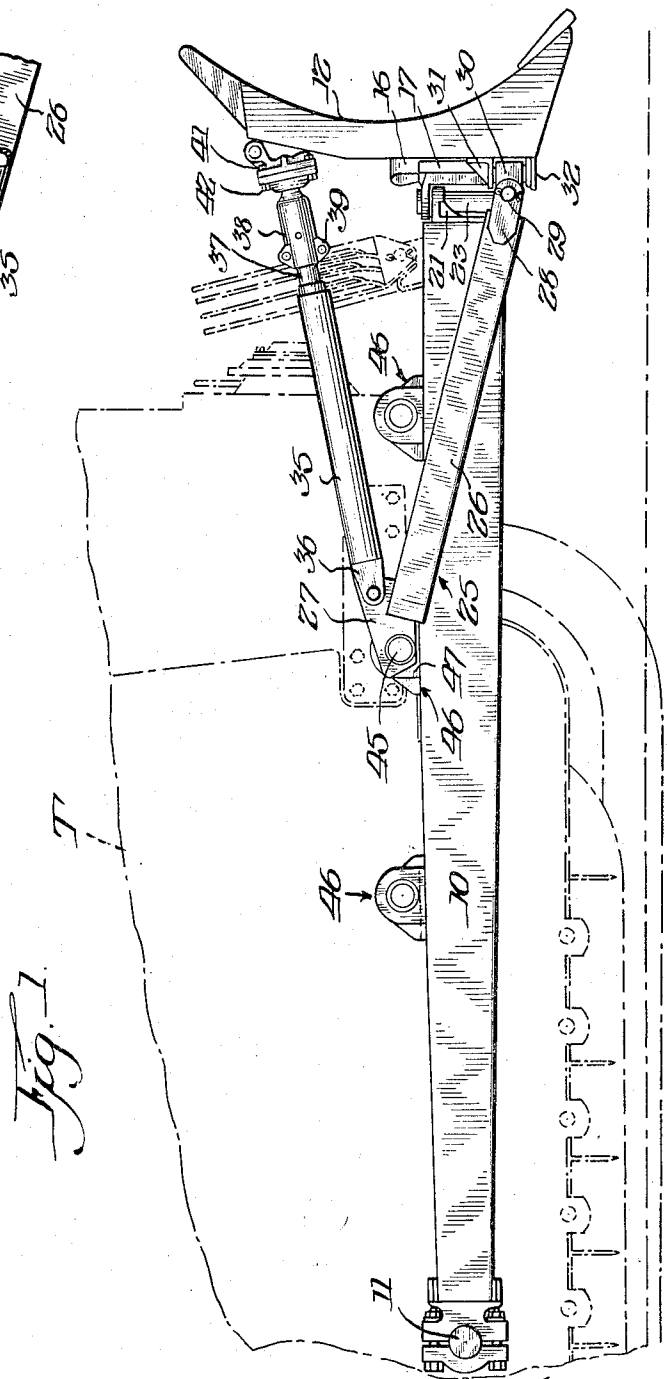


Fig. 1.

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Fig. 3.

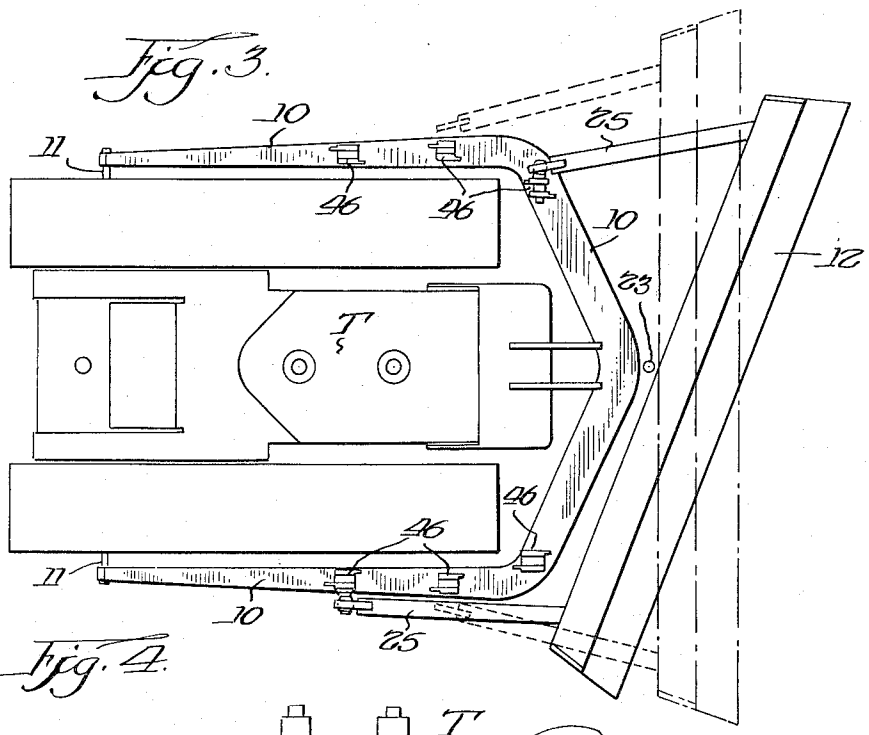


Fig. 4.

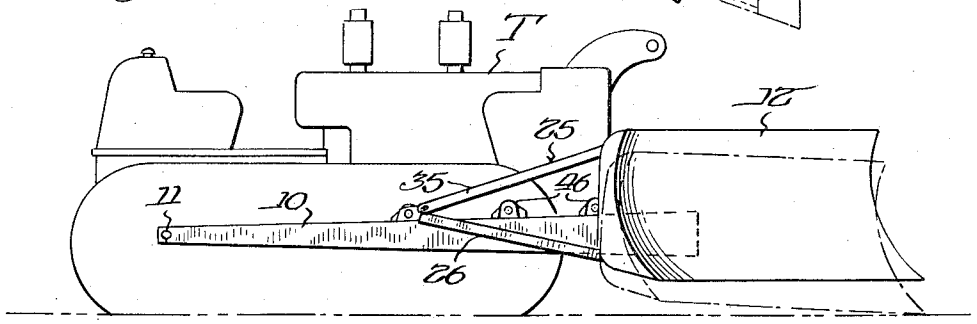
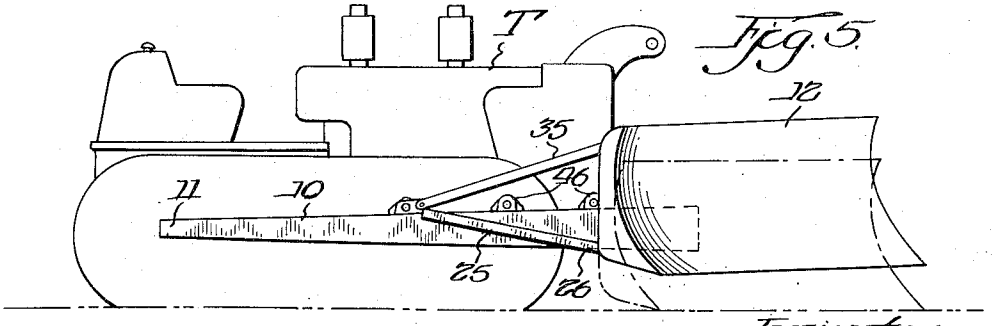


Fig. 5.



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MOLDBOARD TILT COMPENSATION ARRANGEMENT

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Fig. 6.

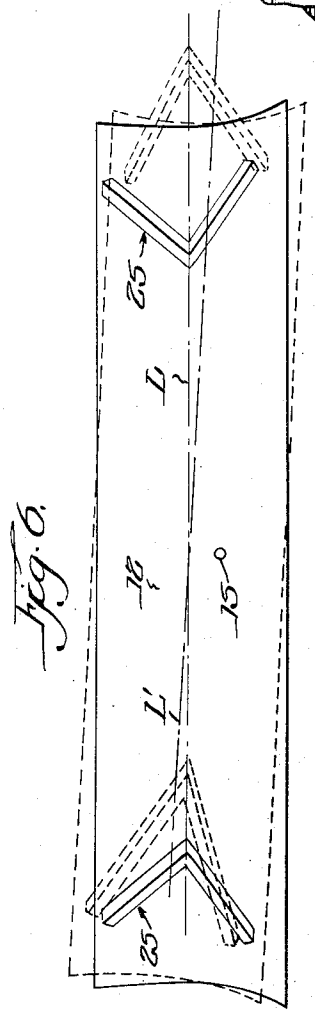
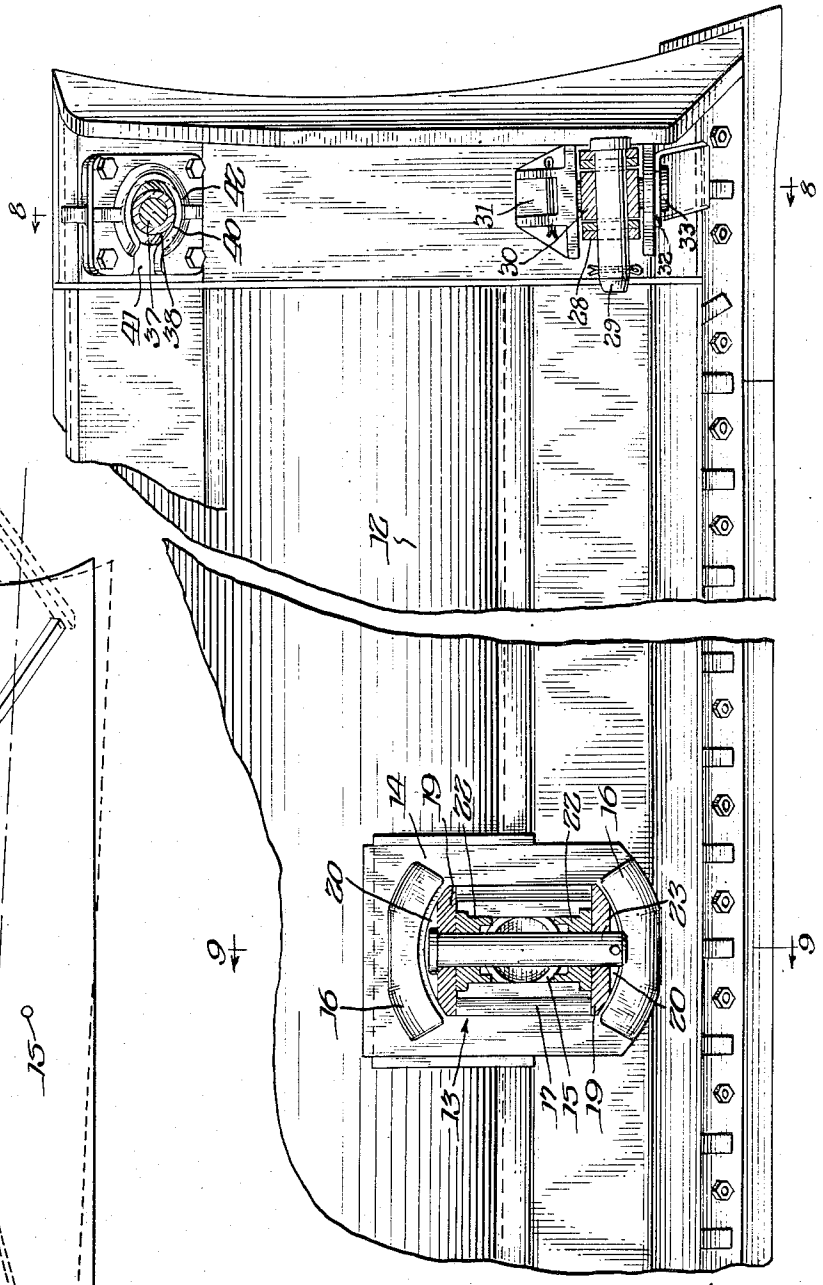


Fig. 7.



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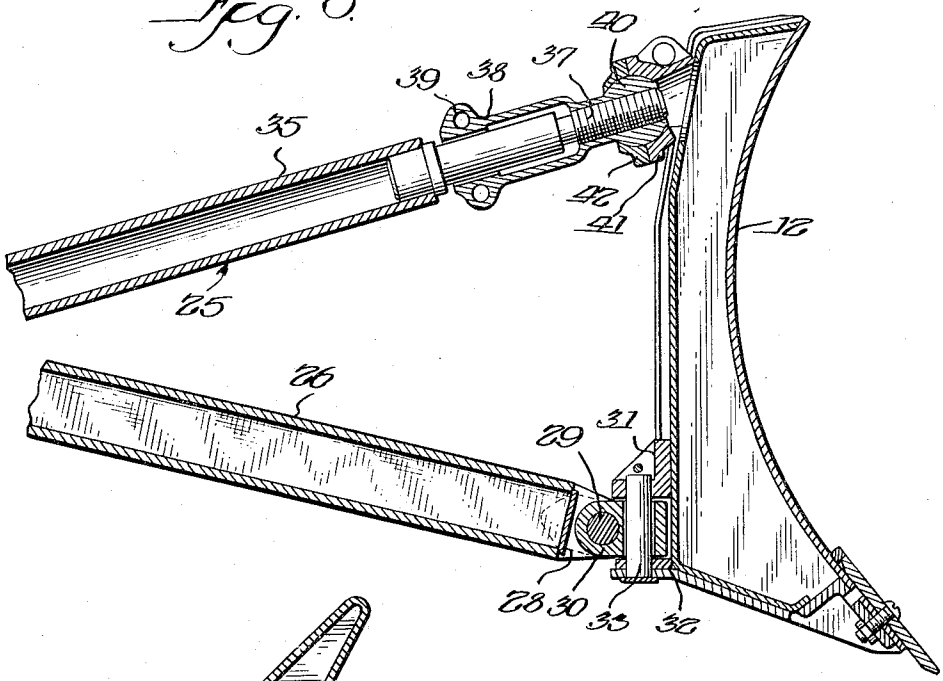
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Fig. 8.



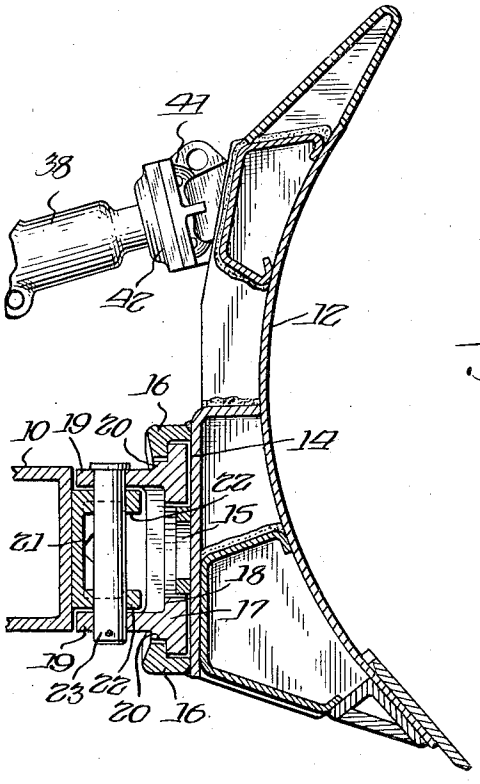


Fig. 9.

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2,777,222

MOLDBOARD TILT COMPENSATION ARRANGEMENT

George S. Allin, Jr., Homewood, Ill., assignor to Pullman-Standard Car Manufacturing Company, Chicago, Ill., a corporation of Illinois

Application August 17, 1953, Serial No. 374,729

9 Claims. (Cl. 37—144)

The present invention relates to a moldboard tilt compensating arrangement for bulldozers or the like, and more particularly to means for automatically compensating for the tilt imparted to a bulldozer moldboard in its lowered operative position when it is disposed in oblique or angled relation for side-casting operation.

The moldboards of bulldozers, or dozers as they are commonly known in the art, are mounted on frames pivoted on tractors so that they may be swung between raised inoperative and lowered operative positions, and arranged to swing both transversely of the frame and relative to the pivot axis of the frame, or in other words both to tilt and to angle in the dozer. When the moldboard or blade is rotated or swung about a substantially vertical axis to extend at an angle to the frame pivot axis, so as to push or cast earth to one side or the other, one of its ends necessarily is disposed farther from the frame pivot axis than the other, so that it swings through a greater arc than the other end when the frame is moved to raise or lower moldboard. Thus with present constructions the angled moldboard in lowered operative position has one end lower than the other, or is tilted, and cannot properly level the ground. The present invention provides an arrangement by which such tilt of the moldboard or blade resulting from its angled disposition relative to its line of movement in digging or pushing or to the pivot axis of the frame on which it is carried is automatically compensated for by an opposite and substantially equal tilt imparted to the moldboard or blade. In the disclosed embodiment of the invention, this result is achieved by pivoting the usual thrust arms to the moldboard by connections providing pivot axes therefor which converge, so that in swinging of the blade or moldboard to a desired side-casting angle, commonly accomplished by shifting one thrust arm forwardly and the other rearwardly along the frame, relative swinging of the arms and moldboard occurs at a slight angle to the horizontal. The blade or moldboard is thus tilted to raise the end of the moldboard swung out from the frame pivot axis and lower the end moved toward that axis, the degree or amount of tilt being substantially equal, but in the opposite direction, to the moldboard tilt which otherwise would occur when the moldboard was disposed in its desired lowered operative position. Because the thrust arms ordinarily extend laterally outwardly at an angle from the frame to the moldboard, the two arms do not swing through equal arcs relative to the moldboard in such angling, with the result that the frame-engaging ends of the thrust arms are displaced vertically relative to each other. To accommodate this relative displacement, certain of the lugs or other bearing means provided on the frame for selective engagement by the thrust arms are vertically offset from the others.

The invention thus provides a simple and automatic compensating arrangement for the tilt inherent in present moldboard mounting constructions when the moldboard or blade is disposed at a side-casting angle, and effects a substantially level condition of the blade or moldboard in its lowered side-casting position so that a perfect leveling operation may be performed with the moldboard at an angle. At the same time, the invention does not interfere in any manner with desired tilting of the moldboard when cutting or grading at an angle to the horizontal transversely of the bulldozer is desired, for any usual means for tilting the moldboard, whether parallel or angled relative to the frame pivot axis, may be employed without being affected by the compensating means of this invention.

The present invention therefore present important operating advanatges over conventional moldboard arrangements while requiring only slight changes in manufacturing procedures and parts.

It is an object of the present invention to provide an arrangement automatically compensating for the tilt of a bulldozer or like moldboard in its lowered operative position when disposed obliquely to its line of movement for side-casting operation.

Another object is the provision in a bulldozer or like earth-moving device of means for automatically compensating for the tilt of the moldboard resulting in its lowered operative position from disposition thereof in an angled side-casting position.

Another object is the provision of pivot connections between the thrust arms and moldboard of a bulldozer or like earth-moving device which provide converging pivot axes causing moldboard tilt opposite to and compensating for the tilt of the moldboard otherwise resulting in its lowered operative position from shifting thereof to an obliquely disposed side-casting position.

Another object of the invention is the provision of a bulldozer or like earth-moving device having an arrangement for effecting substantially level condition of the moldboard in lowered operative position when swung to oblique side-casting position by countervailing the tilt otherwise inherent in the moldboard when so positioned.

A further object is the provision of a bulldozer or like earth-moving device having the thrust arms pivotally connected to the moldboard by means providing converging pivot axes to effect moldboard tilt upon relative swinging of the arms and modlboard in disposing the moldboard in angled side-casting relation in the device to compensate for opposite tilting of the moldboard otherwise effected in lowered side-casting position thereof.

It is another object of the invention to provide in a bulldozer or like earth-moving device an arrangement permitting pivoting of the thrust arms at different levels on the moldboard-carrying frame in compensating for tilting of the moldboard in its lowered operative position when shifted to oblique side-casting relation in the device.

Another object is the provision in a bulldozer or like earth-moving device of a plurality of bearing means in vertically offset relation on the moldboard-carrying frame for selective pivoting of the moldboard thrust arms thereon in compensating for tilting of the moldboard in lowered operative position upon shifting of the thrust arms on the frame to dispose the moldboard in oblique side-casting position.

Still another object is the provision of a bulldozer or like earth-moving device having means for pivoting the moldboard thrust arms at selected points along the moldboard-carrying frame at different levels in shifting of the arms to swing the moldboard to angled side-casting position while compensating for tilted condition of the moldboard in lowered operating position when so angled.

A further object is the provision of a bulldozer or like earth-moving device having thrust arms pivotally con-

nected to the moldboard on converging axes and a plurality of vertically offset bearing means on the frame for selective pivoting of the thrust arms thereon to effect a substantially level condition of the moldboard in lowered operative position when swung to angled side-casting relation in the device by shifting of the arms on the frame.

Other and further objects, advantages, and features of the invention will be apparent to those skilled in the art from the following description, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a side elevation of a bulldozer moldboard and its associated mounting means in raised inoperative position on a tractor of which a portion is shown in broken lines;

Fig. 2 is a broken plan view of the moldboard-carrying frame showing the spaced lugs for selective engagement of a thrust arm on the frame and also showing in full lines an intermediate engaged position of the thrust arm and in broken lines one extreme partially engaged position of the arm;

Fig. 3 is a diagrammatic plan view of a bulldozer showing the moldboard in an angled side-casting position in full line and in straight-casting position in broken lines;

Fig. 4 is a diagrammatic side elevation of a bulldozer lacking the present invention and showing the angled or obliquely disposed moldboard in raised position in full lines and in lowered tilted position in broken lines;

Fig. 5 is a view similar to Fig. 4 but illustrating the tilt compensation accomplished by the invention, the angled moldboard being shown in raised compensatingly-tilted position in full lines and in level lowered position in broken lines;

Fig. 6 is a diagrammatic rear elevation of the moldboard and thrust arms according to the invention, showing in full lines the relative positions of the arms and moldboard in straight-casting but raised position of the moldboard and in dotted lines the relative positions of the parts in raised side-casting and pre-tilted moldboard positions;

Fig. 7 is a broken fragmentary rear elevation of the moldboard showing the pivotal connections thereof to the frame and one thrust arm;

Fig. 8 is a transverse section through the moldboard and one thrust arm pivot connection taken substantially in the plane of line 8—8 of Fig. 7; and

Fig. 9 is a transverse section through the moldboard and its pivotal connection to the frame taken substantially in the plane of line 9—9 of Fig. 7.

Referring to the drawings and particularly to Figs. 1, 2, and 7 to 9 inclusive, there is shown a bulldozer comprising a tractor T of any desired type having a generally U-shaped frame 10, commonly called the C frame or main frame, embracing the sides and front end thereof and pivoted thereto by its arms, as on the horizontal pivots 11, to swing vertically between a raised substantially horizontal position and a lowered position. A blade or moldboard 12 of any desired form, in the present instance shown as of generally hollow construction with a replaceable lower edge structure, is mounted on the forward or connecting portion of the main frame 10 so that it may be lowered and raised to and from operative digging, scraping, or pushing position by swinging of the frame. Any suitable means may be employed for moving the frame, as the pulley and cable arrangement indicated in Fig. 1, hydraulic cylinders, or the like. The moldboard 12 is secured to the forward portion of the frame 10 by a pivot connection generally designated 13, as shown in Figs. 1, 7, and 9, which permits the moldboard to swing, or tilt substantially about the longitudinal axis of the frame, or in other words in its own plane, and also allows the moldboard to swing about a generally vertical axis to a desired angle relative to the pivotal axis of the frame 10. The pivotal connection 13 comprises a bracket plate 14 suitably secured on the rear of the blade or moldboard, to a substantially vertical portion of which is welded an annulus 15 which serves as a pivot or swivel boss. A pair of arcuate flanged or angle-section members 16 centered about the annulus are also welded to the plate 14 in vertically spaced relation to provide a pair of arcuate channels in which are engaged the arcuately formed ends of a swivel plate 17 having a width somewhat less than the distance between the ends of the members 16 and a circular central aperture 18 in which the annulus 15 engages. Projecting rearwardly from the plate adjacent its arcuate ends are a pair of horizontal ears 19 each having an arcuate shoulder 20 engageable with the flange of the adjacent arcuate member 16, and provided with vertically aligned pivot apertures. Welded to the frame 10 is a pivot bracket 21 having forwardly projecting horizontal ears 22 engaging between the ears 19 of the plate 17 and also provided with apertures registrable with the apertures of the ears 19 for the reception of a vertically disposed pivot pin 23 flanged at its upper end and securable against upward displacement by a cotter pin or like means at its lower end after insertion through the ears. It will be clear that the plate 17 may be assembled with the moldboard by disposing it parallel to the plate 14 with the ears 19 vertical and moving it forwardly between the arcuate members 16 to engage on the annulus 15, and then turning the swivel plate 17 to engage its arcuate ends within the members 16. The ears 19 may then be positioned with the pivot apertures in registry with the apertures of the ears 22 of the frame pivot bracket 21 and the pivot pin 23 inserted. The pivotal connection 13 is preferably at the lower portion of the moldboard 12, with the pivot annulus 15 centered substantially on the longitudinal axis of the main frame 10 and in the vertical transverse midplane of the moldboard, and with the vertical pivot axis provided by the pivot pin 23 intersecting the horizontal pivot axis of the annulus.

A pair of thrust arms generally designated 25 are provided for transmitting to the frame 10 and tractor T the loads imposed on the blade or moldboard 12 in operation. These thrust arms are of a known type, in the form of a V, pivoted at the apex on the frame and at the other end to the moldboard. The lower strut 26 of each thrust arm is of fixed length and at its end adjacent the frame has an upwardly extending projection 27 provided with a pivot aperture. At its other end, the lower strut has a pair of pivot lugs 28 through which a hinge pin 29 extends. A swivel block 30 is pivoted on the pin to swing vertically between the lugs, and extends forwardly to connect the strut 26 to the moldboard in pivotal relation. Upper and lower swivel brackets 31 and 32 are secured to the rear of the moldboard adjacent each lower corner thereof, the lower bracket 32 providing a recess in which the lower end of a pivot pin 33 is supported and the upper bracket 31 having an aperture coaxial with the recess through which the pin is disposed to extend through a corresponding bore or opening in the swivel block 30. A cotter pin or the like may be secured in the upper bracket overlying the upper end of the pin to prevent upward displacement thereof. The hinge pin 29 and pivot pin 33 are substantially at right angles to each other, but the brackets are mounted to dispose the pivot pin at a slight angle, so that the pivot axis provided by it is not vertical but inclined upwardly and inwardly relative to the adjacent end of the moldboard, as shown in Fig. 7, for a purpose explained hereinafter. The upper strut 35 of each thrust arm 25 has a rear clevis end 36 pivoted on the projection 27 of the lower strut 26 by a suitable pin and at its forward end has a threaded extension 37. A sleeve 38 provided with apertured ears 39 adjacent its rear end and having a spherical head or ball 40 formed at its forward end on a reduced neck portion receives the extension 37, the threaded portion of which engages in an internally threaded bore in the neck and ball 40. The length of the upper strut 35 may thus be varied by rotating the sleeve 38 to advance or retract the ball along the

threaded portion. The ball 40 is received in a socket provided by a socket member 41 secured on the rear of the moldboard at an upper corner and a cap 42 cooperating with the member 41 to present a spherical surface corresponding to that of the ball 40. The cap may be secured to the socket member in any suitable manner, as by bolts extending through engaging flanges of these parts. The ball and socket joint thus provided for pivotally connecting the upper thrust arm strut 35 and moldboard 12 is located so that the inclined or angled pivot axis provided by the pin 33 at the adjacent lower corner of the moldboard passes through the center of the ball 40, as shown in Figs. 7 and 8. The apertured ears 39 of the ball sleeve 38 are employed to receive a bar or the like to provide leverage in turning the sleeve. It will be apparent that the pivot axes of the thrust arms on the moldboard converge upwardly.

For pivotally connecting the thrust arms 25 to the main frame 10, each arm is provided with a trunnion pin 44 having a spherical head 45 journaled in the rear portion of the lower strut projection 27 to provide a ball and socket connection therewith. The trunnion pin is engageable in any of a plurality of lugs 46, in this case three, secured on each side of the frame 10 in longitudinally spaced relation therealong, as best shown in Figs. 1 and 2. Each lug has a base secured to the upper surface of the frame and a pair of vertical ears 47 generally parallel to the longitudinal axis of the frame and each having a circular aperture therein. The trunnion pin 44 is passed through the ears 47 from the laterally outer side of the lug, as indicated in broken lines in Fig. 2, and has its free end projecting laterally inwardly beyond the lug. A pin or like means may be passed through a diametrical bore in the trunnion pin to secure it against accidental withdrawal from the lug. In the present instance, the trunnion pins are of stepped formation to facilitate insertion in the lugs, and the apertures of the laterally outer and inner ears are correspondingly of different radii, but coaxial, for proper reception of the pin 44. As shown in Fig. 1, the two forward lugs 46 on each side of the frame are mounted with the aperture axes in the same plane, while the rear lug is offset slightly from the other two so that its aperture axis is below the plane of the two forward lug axes. In the present embodiment of the invention, the sides of the frame taper rearwardly from the middle lugs, conveniently providing for the downward offset of the rear lugs. As evident from Fig. 2, the middle and rear lugs on each side are substantially aligned longitudinally of the frame 10, but the forward lug is offset laterally inwardly thereof, in the present instance. The particular location of the lugs, however, may vary with the particular proportions of the thrust arms, moldboard, frame, and other parts and the positions which it is desired the moldboard be capable of assuming.

In what may be considered the normal or straight-casting position of the moldboard 12, it is arranged substantially parallel to the pivot axis of the frame 10, as shown diagrammatically in broken lines in Fig. 3, so that when lowered to operative position from the raised position as shown in Fig. 1, it will dig or scrape and push directly forward the earth or other material into which it is forced as the tractor T is driven ahead. The moldboard is disposed in this position by engaging the rear ends of the thrust arms 25 with the middle lugs 46 on the respective sides of the frame, as shown in Fig. 3, by insertion of the trunnion pins 44 therein as already explained. To dispose the moldboard at an angle to the frame pivot axis, so that it progressively moves material to one side or the other as it is pushed forwardly by the tractor, one of the thrust arms is engaged with the rear lug on one side and the other with the forward lug on the other side, as diagrammatically shown in Fig. 3 in full lines. In this figure, the right thrust arm is indicated as engaged with the right rear lug, and the left arm as connected to the left forward lug. This of course necessitates swinging of the moldboard about the vertical pivot pin 23 to bring its right-hand end sufficiently far back toward the frame pivot axis to allow the thrust arm to reach the rear lug, and the left-hand end of the moldboard sufficiently forward to permit the left-hand thrust arm to engage with the forward lug on the left side of the frame. So disposed, the moldboard is in its right-casting position for urging material to the right of the path of the tractor T. To place the blade or moldboard 12 in left-casting position, the disposition of the thrust arms would be reversed, as will be obvious. For convenience, the angular positioning of the moldboard relative to the pivot axis of the frame is ordinarily accomplished in its inoperative raised position, free of the ground, although it may be done with the blade lowered, if desired.

It will be clear that in the straight-casting position of the blade its lower edge will always be substantially level regardless of how high or low it may be swung about the frame pivot axis, and there is no problem in obtaining a level cut in straight-casting operation. When the moldboard is disposed obliquely, or in other words at an angle to the frame pivot axis, one of its ends is farther from that axis than the other. While in the raised position the moldboard is level even though angled, in lowered position the end farther from the frame pivot axis, swinging about the axis on a longer radius than the other end and therefore moving a greater vertical distance, is at a lower level than the other end, so that the moldboard is tilted about the longitudinal axis of the frame. This is illustrated diagrammatically in Fig. 4, in which the moldboard is shown in full lines in its raised and angled position, but in level condition, and in broken lines in lowered angled position, with the resulting tilted condition exaggerated for clearness. While the moldboard is shown as angled for right-casting operation, the moldboard would of course assume corresponding positions when raised and lowered if disposed for casting to the left. The tilted condition of the moldboard in lowered operative position occurs whenever it is shifted to angled position, wherether this is done in raised or in lowered position. In order to obtain a level cut, it is necessary to adjust the moldboard manually by tilting it in the opposite direction. This tilt adjustment of the moldboard is accomplished by turning the sleeve 38 of the thrust arm at the forwardly-extended end of the moldboard in a direction to move the upper strut 35 rearwardly relative to the ball 40, increasing the effective length of this strut and thus applying force to the projection 27 to rotate it rearwardly about the trunnion pin head and swing the lower strut 26 upwardly, raising the moldboard end. The sleeve 38 at the other end of the moldboard is rotated to shorten the upper strut 35 so as to swing the lower strut downwardly and thus lower the moldboard end. The turning of the two sleeves must be done simultaneously, requiring at least two men, or one thrust arm must be disengaged from the frame, while adjustment is made at the other end of the moldboard, and then adjusted and re-engaged with the frame. Considerable time and labor is required to make the tilt adjustment manually, and there is no assurance that exact compensation for the initial moldboard tilt will be achieved, for mere visual observation of the moldboard is relied upon to determine when it has been brought more or less to level condition.

Exact and automatic compensation for the moldboard tilt resulting in lowered operative position from the angled or oblique disposition of the moldboard is effected by the present invention. This is accomplished by the disclosed arrangement inclining toward each other the pivot axes of the thrust arm connections with the moldboard. As shown in full lines in Fig. 5, the moldboard when obliquely disposed is tilted so that the end farther from the frame pivot axis is raised while the other end is lowered, so that when the moldboard is in the lowered operative position indicated in broken lines, it is substantially level. In other words, the moldboard has imparted

to it a compensating tilt opposite and substantially equal to the moldboard tilt resulting in lowered position from the difference in radial spacing of its ends from the frame pivot axis. The effect of the converging pivot axes of the thrust arm and moldboard connections will readily be apparent from a consideration of Fig. 6, which diagrammatically shows the moldboard in two positions, viewed in each position directly from the rear. In full lines, the moldboard **12** is shown in its straight-casting, level position corresponding to its broken-line position as shown in Fig. 3, with the thrust arms **25** extending inwardly and rearwardly to the respective middle lugs. The line L represents the plane of the aperture axes of the forward and middle lugs on each side of the frame **10**, the rear ends of the thrust arms of course lying in this plane. When the moldboard is swung to the right-casting position, both thrust arms swing to the right relative to the moldboard, but because of their converging pivot axes the rear end of the left thrust arm moves downwardly relative to the moldboard or the plane of the forward and middle lug aperture axes, while the right thrust arm swings upwardly as well as to the right. Since the rear ends of the thrust arms, being merely shifted from one lug to another on the frame, remain substantially in the same plane as before, the moldboard is caused to tilt about the axis of the annulus **15**, its left end being raised and the right end lowered, as shown in dotted lines in Fig. 6, and corresponding generally to the full-line position of Fig. 5. This is the pre-tilted condition desired for the moldboard to compensate for the tilt otherwise resulting in its lowered position when disposed at an angle to the frame pivot axis, and effects a level condition of the angled moldboard in lowered position, as previously explained. The broken line L' in Fig. 6 represents the position which the plane of the axes of the forward and middle lugs would have relative to the moldboard if the moldboard were held against tilting when swung to angled position, or in other words corresponds to the line L in the illustrated full-line position. The lowering of the rear end of the left thrust arm and the raising of the right thrust arm end with reference to the plane indicated by the line L', in the right-swung position, will be clear from this representation. The actual location of the left thrust arm end in the same plane, indicated by the line L, when engaged in the middle lug for straight casting or in the forward lug for right-side casting, is apparent from the figure. It will also be seen that although the frame-connectible end of the right thrust arm in the right-casting position is raised relative to the moldboard with reference to its location in the straight-casting position, it lies below the plane represented by the line L; and this is true even though, as evident from Fig. 3, the right thrust arm swings through a greater angle relative to the moldboard in angling of the moldboard than does the left thrust arm, and therefore its trunnion end moves upwardly relative to the moldboard a greater distance than the left thrust arm end moves downwardly. This is due to the downward swinging of the right moldboard end about the tilt axis, or axis of the annulus **15**, carrying the right thrust arm downwardly a greater distance than the thrust arm end moves upwardly. That is, the thrust arm end swings down about the tilt axis farther than it swings upwardly about the inclined thrust arm pivot axis. In the compensatingly tilted condition of the moldboard, therefore, the trunnion end of the right thrust arm is located below the plane of the middle and forward lug axes, and the rear lug is offset downwardly relative to the other lugs to accommodate this difference in vertical displacement. The amount of offset corresponds to the spacing of the trunnion end from the line L in Fig. 6.

It is to be noted that the offset depends upon several factors, such as the distance of the thrust arm pivot axis from the moldboard tilt axis, the inclination of the arm pivot axis, and the angles through which the thrust arms swing relative to the moldboard in angling of the moldboard. It should also be noted that while in the embodiment illustrated the inclined pivot axes of the thrust arms on the moldboard converge upwardly because the thrust arms in the straight-casting position extend at an angle outwardly and forwardly from the frame **10**, the reverse would be true and the thrust arm axes inclined toward each other downwardly should the thrust arms be arranged to extend at angles inwardly and forwardly of the frame. Although this latter construction is an impractical one, it serves to emphasize the fact that the invention is not limited to the illustrative embodiment disclosed and is applicable to blade or moldboard mounting arrangements of different types of proportions involving the same problem of tilt compensation.

What is claimed is:

1. A bulldozer or like earth-moving device including a generally U-shaped frame embracing the sides and one end of a vehicle and pivoted thereto by its arms to swing between raised and lowered positions, a moldboard longer than the width of the frame having a pivotal connection to the frame permitting tilting of the moldboard relative to the frame about substantially the longitudinal frame axis and swinging of the moldboard about an axis substantially perpendicular to said longitudinal axis to selected angles relative to the pivot axis of the frame, means for raising and lowering the frame and moldboard, a pair of thrust arms for angling the moldboard each having one end connectible to a side of the frame and the other pivotally connected to the moldboard adjacent an end thereof and extending at an angle outwardly from the frame in position of the moldboard substantially parallel to said frame pivot axis, and a plurality of bearing means adapted for engagement with said frame-connectible thrust arm ends spaced along each side of the frame each aligned transversely with a bearing means on the other frame side with certain of the bearing means offset vertically relative to the others, the pivot axes of the moldboard connections of the thrust arms converging upwardly, whereby in angling of the moldboard the thrust arms are engaged with a selected bearing means and swing relative to the moldboard about said converging axes in intersecting planes and through different arcs to effect tilting of the moldboard oppositely to and in compensation for moldboard tilting in lowered position resulting from the difference in radial spacing of the moldboard ends from the frame pivot axis due to the moldboard angling and the frame-connectible thrust arm ends are engaged with bearing means at different levels accommodating the difference in vertical displacement thereof resulting from the different arcs described thereby in said relative swinging and the swinging of the thrust arms with the moldboard in tilting thereof.

2. A bulldozer or like earth-moving device including a generally U-shaped frame embracing the sides and one end of a vehicle and pivoted thereto by its arms to swing between raised and lowered positions, a moldboard longer than the width of the frame carried by the frame tiltable relative to the frame substantially about the longitudinal axis thereof and swingable about a substantially vertical axis to selected angles relative to the pivot axis of the frame, means for raising and lowering the frame and moldboard, a pair of thrust arms for angling the moldboard each having one end connectible to a side of the frame and the other pivotally connected to the moldboard adjacent an end thereof and extending at an angle outwardly from the frame in position of the moldboard substantially parallel to said frame pivot axis, and a plurality of bearing means adapted for engagement with said frame-connectible thrust arm ends spaced along each side of the frame each aligned transversely with a bearing means on the other frame side, the pivot axes of the connections of the thrust arms to the moldboard converging upwardly, whereby in angling of the moldboard the thrust arms are engaged with selected bearing means and swing relative to the moldboard about said converging axes to effect tilting of the moldboard oppo-

site to and in compensation for moldboard tilting in lowered position resulting from the difference in radial spacing of the moldboard ends from the frame pivot axis due to the angling of the moldboard.

3. A bulldozer or like earth-moving device including a generally U-shaped frame embracing and pivoted on a vehicle to swing between raised and lowered positions, means for raising and lowering the frame, a moldboard carried by the frame tiltable about substantially the longitudinal frame axis and swingable to selected angles relative to the pivot axis of the frame, a plurality of bearing means spaced along each side of the frame, and a pair of thrust arms for angling the moldboard each having one end selectively engageable with the bearing means at one frame side and the other end pivotally connected to the moldboard, the pivot axes of the connections of the arms to the moldboard converging, whereby engagement of the frame-connectible thrust arm ends with selected bearing means to dispose the moldboard at an angle to the frame pivot axis causes relative swinging of the thrust arms about said converging axes to raise the end of the moldboard disposed farther from the frame pivot axis and lower the other moldboard end to compensate for the oppositely tilted condition of the moldboard in lowered operative position otherwise resulting from the difference in the radial spacing of the moldboard ends from the frame pivot axis.

4. A dozer or like earth-moving device comprising a frame vertically swingable on a vehicle and carrying a moldboard tiltable in its own plane and swingable to selected angles relative to the pivot axis of the frame, means for swingingly raising and lowering the frame and moldboard about the frame pivot axis, a pair of thrust arms for determining the angle of the moldboard each connectible at one end to the frame at selected points thereon and pivotally connected at the other end to the moldboard to extend at an angle outwardly from the frame in position of the moldboard substantially parallel to the frame pivot axis, the pivot axes of the connections of the thrust arms to the moldboard converging upwardly.

5. A dozer or like earth-moving device comprising a frame pivoted on a vehicle to swing vertically, a moldboard carried by the frame tiltable about a substantially horizontal axis and swingable to extend at an angle to the pivot axis of the frame, means for swinging the frame to raise and lower the moldboard, a pair of thrust arms for determining the angle of the moldboard relative to the frame pivot axis each connectible at one end to the frame at selected points thereon and pivotally connected at the other end to the moldboard, the pivot axes of the thrust arm connections to the moldboard being angled toward each other.

6. A dozer or like earth-moving device comprising a frame vertically swingable on a vehicle and carrying a moldboard tiltable transversely of the frame and swingable to selected angles relative to the pivot axis of the frame, a pair of thrust arms for determining the angle of the moldboard each connectible at one end to the frame at selected points thereon, and pivotal connections between the other ends of the thrust arms and the moldboard providing pivot axes angled toward each other.

7. In a bulldozer or like earth-moving device including a generally U-shaped frame embracing and pivoted on a vehicle by its arms to swing between raised and lowered positions, a moldboard longer than the width of the frame carried by the frame tiltable about substantially the longitudinal axis of the frame and swingable to selected angles relative to the pivot axis of the frame, means for raising and lowering the frame and moldboard, a pair of thrust arms for determining the angle of the moldboard each having one end connectible to a side of the frame and the other end pivotally connected to the moldboard laterally outwardly of the frame in moldboard position substantially parallel to the frame pivot axis, and a plurality of bearing means adapted for engagement with said frame-connectible ends of the thrust arms spaced along each side of the frame, the improvements comprising mounting certain of the bearing means in vertically offset relation to the others, and pivotal connections between said thrust arms and moldboard providing pivot axes converging upwardly toward each other, whereby upon engagement of said frame-connectible thrust arm ends with selected bearing means to dispose one end of the moldboard farther from the frame pivot axis than the other end thereof the thrust arms swing relative to the moldboard in different planes and through different arcs to raise said one moldboard end and lower the other end in compensation for lowering of said one end and raising of the other resulting in lowered position of the moldboard from the radial spacing of said one end farther from the frame pivot axis than the other moldboard end, and the offset bearing means accommodate the difference in vertical displacement of the frame-connectible thrust arm ends due to the difference in the lengths of the arcs described thereby in said relative swinging and the swinging of the thrust arms with the moldboard in tilting thereof.

8. In a bulldozer or like earth-moving device comprising a generally U-shaped frame embracing and pivoted by its arms to a vehicle to swing between raised and lowered positions, a moldboard longer than the width of the frame mounted on the frame to tilt transversely of the frame and to swing to selected angles relative to the pivot axis of the frame, means for raising and lowering the frame and moldboard, and a pair of thrust arms for determining the angle of the moldboard each having one end connectible to a side of the frame at selected points thereon and the other end pivotally connected to the moldboard laterally outwardly of the frame in moldboard position substantially parallel to the frame pivot axis, the improvement comprising pivotal connections between said thrust arms and moldboard providing pivotal axes converging upwardly, whereby engagement of said frame-connectible thrust arm ends at selected points on the respective frame sides to dispose one end of the moldboard farther from the frame pivot axis than the other moldboard end effects swinging of the thrust arms relative to the moldboard about said converging axes to cause tilting of the moldboard to raise said one end and lower said other end thereof in compensation for opposite tilting of the moldboard in lowered position due to the radial spacing of said one end farther from the frame pivot axis than said other end and thereby effect a substantially level condition of the moldboard in lowered operative position.

9. In a dozer or like earth-moving device including a frame vertically swingable on a vehicle and carrying a moldboard tiltable transversely of the frame and swingable to selected angles relative to the pivot axis of the frame, means for swinging the frame to raise and lower the moldboard, and a pair of thrust arms for angling the moldboard each having one end connectible to the frame at selected points thereon and the other end pivotally connected to the moldboard, the improvement comprising means automatically compensating for the moldboard tilt in lowered position of the moldboard when angled relative to the frame pivot axis resulting from the difference in radial spacing from the frame pivot axis of the ends of the angled moldboard, said compensating means comprising pivotal connections between said thrust arms and moldboard providing pivot axes angled toward each other.

References Cited in the file of this patent

UNITED STATES PATENTS

2,239,943	Sword	Apr. 29, 1941
2,311,553	LeTourneau	Feb. 16, 1943