May 21, 1957 R. P. HARSHBERGER 2,792,769

EARTH WORKING MACHINE OR THE LIKE

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Fig. 1

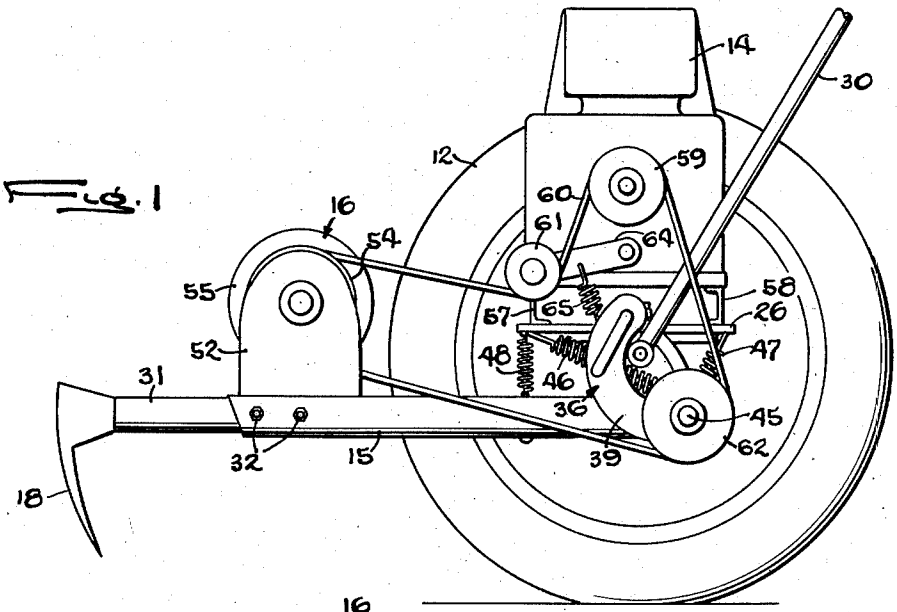


Fig. 3

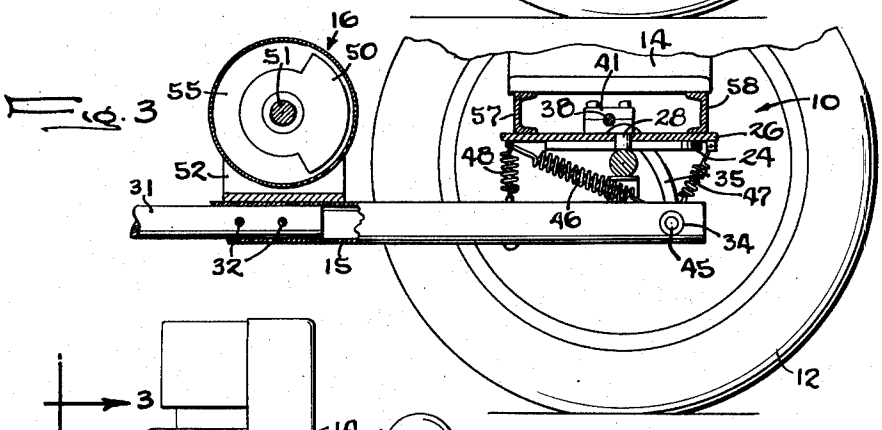
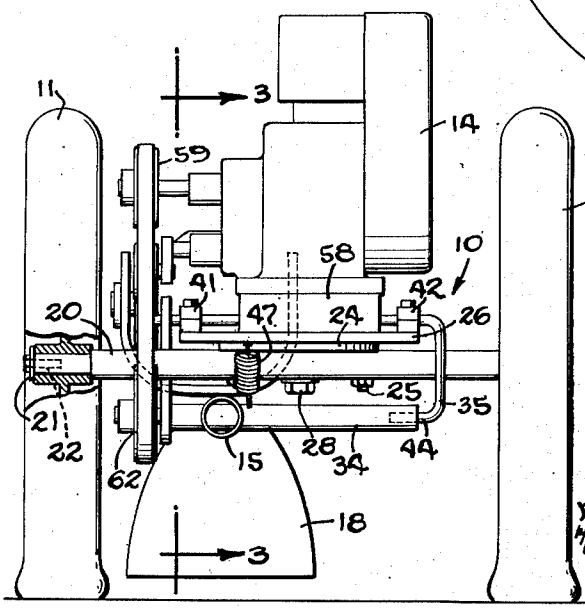


Fig. 2



INVENTOR
Russell P. Harshberger
by Carlson, Pitzner, Hubbard & Wolfe
ATTORNEYS

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Fig. 4

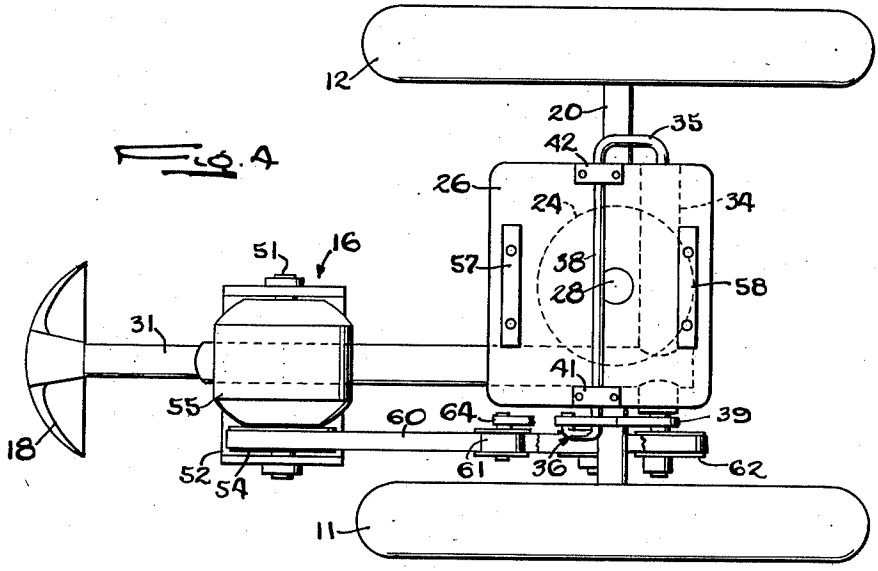


Fig. 5

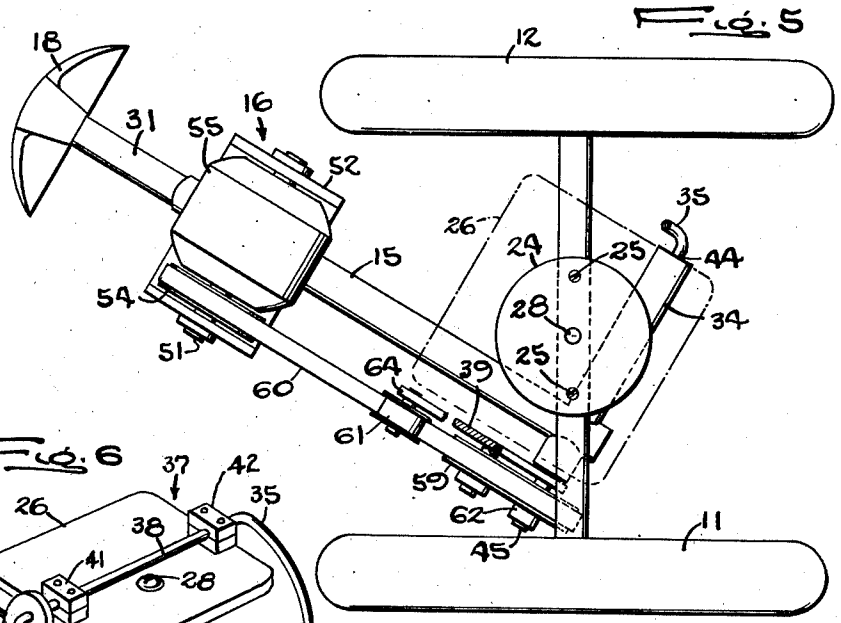
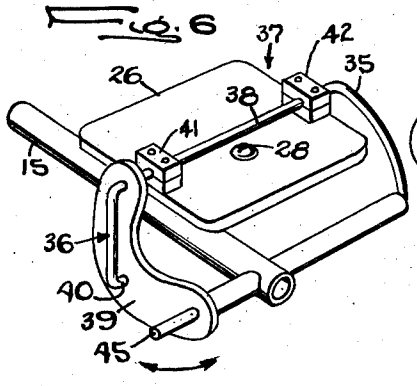


Fig. 6



INVENTOR
Russell P. Harshberger
By Carlson, Pitzner, Hubbard & Wolfe
ATTORNEYS

May 21, 1957 R. P. HARSHBERGER 2,792,769

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Fig. 7

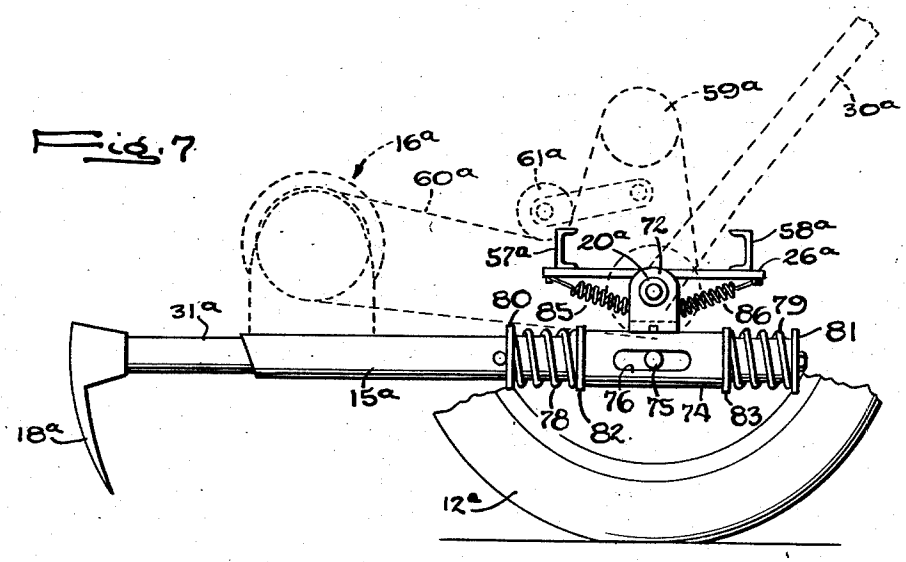
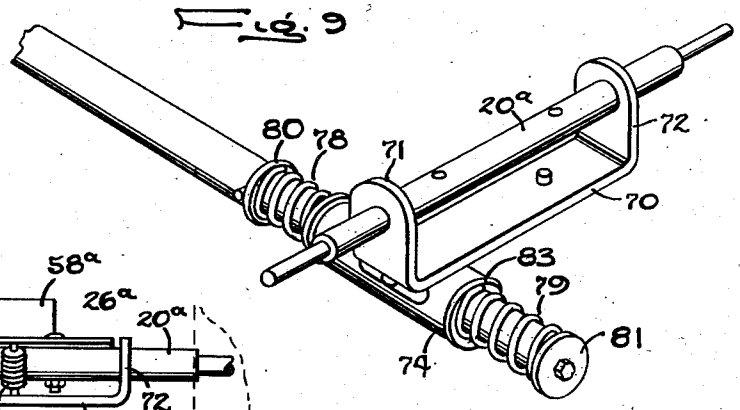


Fig. 9



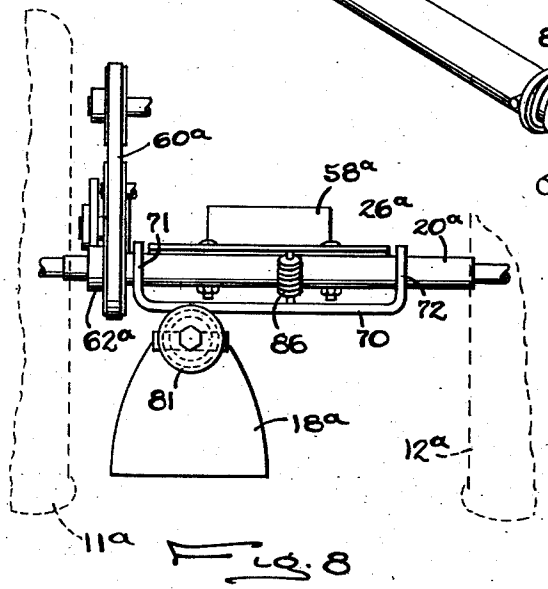


Fig. 8

INVENTOR

Russell P. Harshberger

By Carlson, Pitzner, Hubbard & Wolfe

ATTORNEYS

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2,792,769

EARTH WORKING MACHINE OR THE LIKE

Russell P. Harshberger, Altadena, Calif.

Application September 1, 1953, Serial No. 377,834

17 Claims. (Cl. 97—34)

The present invention relates to power driven implements of the type having a swinging arm for performing chopping, tamping, or similar operations. It finds particular advantage, for example, in light earth working or cultivating machines of the class employing a wheel supported chassis and having an extending, vertically swingable tool arm subjected to orbital movement by eccentric mass means rotatably driven from a power plant on the chassis.

It is the general aim of the present invention to provide improvements in machines of the character described above, both as to their control, maneuverability, versatility in use, and as to the isolation of vibrations set up by the motion of the tool and tool arm.

More specifically, it is an object of the invention to provide a machine of the foregoing type in which the tool on an extending tool arm may be varied in lateral position, transverse to the direction of chassis translation, to work effectively either directly ahead of the chassis or in between and around plants placed in rows.

Consonant with the foregoing, it is another object of the invention to provide a machine having but a single tool arm, vertically swingable but also angularly positionable in a horizontal sense with respect to the chassis and its direction of translation.

A further object is the provision of an improved eccentric revoluble mass mechanism for a machine of the character described, capable of imparting orbital motion to a single tool arm.

Another object of the invention is to provide in such a machine, a tool arm vertically swingable under the influence of orbital motion imparted thereto, together with means for absorbing and substantially isolating from the chassis thrust components axial of the tool arm arising as an incident to such motion.

Still another object of the invention is the provision of means for cushioning and stabilizing the tool arm in a selected horizontal angular orientation with respect to the chassis of such a machine.

Further objects and advantages will become apparent as the following description proceeds, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a side elevation of an illustrative power-driven implement having a swinging arm and embodying the present invention;

Fig. 2 is a rear elevation of the machine;

Fig. 3 is a vertical section taken substantially along the line 3—3 in Fig. 2;

Fig. 4 is a plan view of the machine, with the power plant omitted for the sake of clarity;

Fig. 5 is similar to Fig. 4, showing the tool arm and tool in a different position lateral of the chassis;

Fig. 6 is an enlarged detail view, in perspective, of the components for mounting the tool arm on the chassis;

Fig. 7 is a vertical side section, partially in broken outline, of a modified embodiment of the invention;

Fig. 8 is a fragmentary rear elevation, partially in broken outline of the modified embodiment; and

Fig. 9 is an enlarged detail view, in perspective, of the modified tool arm mounting components.

Although particular embodiments of the invention have been shown and described in some detail, there is no intention to thereby limit the invention to such details. On the contrary, it is intended here to cover all alterations, modifications, and equivalents falling within the spirit and scope of the invention as defined in the appended claims.

Referring now to the drawings, and particularly to Figs. 1 through 6, the invention is here shown embodied in an illustrative power-driven implement, in this instance an earth working machine or cultivator for performing a chopping or hoeing operation. The machine comprises a chassis **10** translatable on a pair of ground wheels **11** and **12**, the chassis in turn supporting a power plant **14** and a horizontally extending, vertically swingable tool arm **15**. The latter has near its extremity a revoluble eccentric mass mechanism **16** adapted to be driven by the power plant **14**. A tool **18** at the extremity of the arm **15**, here shown as a hoe-like blade attachment, is thus successively engaged with the ground with a chopping, clawing action as the tool arm swings vertically.

In prior machines the use of a pair of interconnected vertically swinging tool arms pivoted at spaced points on a chassis made the arms and chassis rigid and fixed in a horizontal sense. The spaced arms allowed no room for lateral adjustment relative to the chassis; and the tool was always directly in front of the chassis and could not work in between or close to plants placed in rows. Additionally, the arms transmitted to the chassis axial vibrations and transverse horizontal angular forces arising upon a sidewise deflection of the tool. The entire chassis thus shook axially of the tool arms and was difficult to control. Upon a tool striking a sidewise glancing blow on a root or rock the entire chassis was laterally whipped or skewed.

In the practice of the present invention, these difficulties are substantially eliminated by the provision of the single tool-carrying arm **15** extending from the chassis **14** and adjustable in angular position with respect to the direction of translation of the latter (compare Figs. 4 and 5). Means are provided for floatably suspending the tool arm **15** from the chassis not only to permit the former to swing freely in a vertical plane, but also to permit it to have limited axial movement and horizontal angular deflection from its selected orientation, for example, under the influence of a sidewise force on the tool **18**. Means are additionally provided, however, yieldably to restrain and cushion the latter two movements, preventing their complete transfer to the chassis **10**.

The chassis **10** as here shown comprises an axle **20** journaling the two wheels **11**, **12** at either end. The wheel hubs are fitted over reduced end portions of the axle for rotation thereon, and removably secured by retaining washers **21** and bolts **22**. A base member **24** here shown as a circular plate is held fast on the medial portion of the axle **20** in horizontal disposition by a pair of bolts **25** (Fig. 2). The circular plate **24** in turn supports a mounting base or plate **26** adapted to be angularly adjusted in relative position. For this purpose, the mounting plate **26** is held in faced, slidable abutment with the circular plate **24** by a king bolt **28** extending through the axle **20**. Tightening of a nut on the king bolt **28** locks the two plates **24**, **26** in selected or adjusted angular relation.

The chassis is also equipped with a suitable handle bar **30** (partially shown) preferably of an inverted U-shape with its arms rigidly secured to the axle **20** just inboard of either wheel. The handle **30** serves to permit the propulsion or translation and guiding of the chassis **20** on the wheels **11**, **12** by a single operator, al-

though it will be understood that a power drive to the wheels may also be employed.

The tool arm **15** in the present instance is in the form of an elongated tubular member, adapted at its free extremity for the removable attachment of the tool **18**. The tool **18** here illustrated is a hoeing tool having a sharpened blade vertically depending from a shank **31** socketed in the tool arm and locked by bolts **32**.

The tool arm **15** is floatably suspended at its other end from the mounting plate **26** and for this purpose has a transverse member **34** rigidly secured, as by welding, to it. The transverse member **34** is adapted to be pivoted about its longitudinal axis to permit vertical swing of the tool arm **15**. As here shown, it is hollow or tubular, and is so pivoted between spaced depending arm portions **35, 36** of a swinging carriage assembly **37**. This assembly (Fig. 6) may be of generally inverted U-shape, including a shaped torsion member or rod forming the bridge portion **38** and the right arm **35** of the U. The left arm **36** is provided by a brace or strut **39** which is pivotally carried at its upper end on the bridge portion, and apertured at its medial portion to receive an inturned stub **40** of the torsion rod. The bridge portion **38** is pivotally retained along the upper surface of the mounting plate **26** by a pair of spaced pedestal bearings **41, 42**. An inturned stub **44** on the right arm **35** is inserted into the right end of the transverse member **34**, while a stud **45** secured in the latter's opposite end is pivotally received in an opening located at the lower end of the brace **39**.

The tool arm **15** may, by this arrangement, swing vertically with the transverse member **34** pivoting about its longitudinal axis. But the swinging carriage assembly **37** also rocks freely in the pedestal bearings **41, 42** affording axial movement of the tool arm **15**. The torsion member additionally permits, yet cushions and restrains, swinging or skewing of the tool arm in a horizontal plane with respect to the mounting plate, as more fully described below.

The suspension of the tool arm **15** further includes means for absorbing and isolating from the chassis **10** axial thrusts on the tool arm. Such means may take the form of a pair of resilient members or tension springs **46, 47** interposed between the transverse member **34** and the underside of the mounting plate **26**. As the carriage **37** rocks in the pedestal bearings **41, 42**, these absorb and cushion its thrust. A third tension spring **48** is connected between the mounting plate **24** and the medial portion of the tool arm **15** for the purpose of lifting the tool **18** clear of the ground when the handle **30** is depressed, i. e., when the chassis is tilted backwardly between the wheels.

The tool **18** is given a vertical chopping and clawing motion by the eccentric mechanism **16** mounted on the tool arm **15** and driven by the power plant **14**. Such mechanism comprises an off-center mass or eccentric flywheel **50** mounted on a horizontal, transverse shaft **51**. The shaft **51** is journaled between spaced, upright flanges of a bracket **52** secured, as by welding, near the free extremity of the tool arm **15** and carries a pulley **54** at one side. A casing or housing **55** for the flywheel prevents accidental contact with the latter, which when rapidly rotating might hurt, or itself be damaged by, foreign objects.

The power plant **14** is here shown in outline as a gasoline engine or the like, although it will be apparent that other forms, such as an electric motor, may be employed. It is bolted to a pair of spaced channel irons **57, 58** secured, as by welding, to the mounting plate **26**. Driving connection is made from an output pulley **59** of the engine to the flywheel pulley **54** by means of a belt **60** which passes also around a belt-tightening pulley **61** and a spacing pulley **62** journaled on the stud **45** in the left end of the transverse member. The belt tightening pulley **61** is carried at the free end of a swinging lever **64** pivoted on the engine and biased by a spring **65** into tightening position. The engine thus serves to drive the eccentric flywheel **50** regardless of the vertical position of the tool arm **15**; the belt-tightening pulley **61** automatically compensating tension in the upper belt flight. Since the flywheel pulley **54** transverses an arc about the center of the spacing pulley **62**, no change in the distance of the lower flight occurs. The tension in the lower flight of the belt is taken by the brace **39**, i. e., the left arm of the swinging carriage assembly **37**.

In operation, the inertia and centrifugal forces created by the rapidly rotating eccentric flywheel **50** impart an orbital or gyratory motion to the tool arm **15**. The vertical components of such forces result in a vertical swinging of the tool and tool arm about the longitudinal axis of the transverse member **34**, which pivots about the right stub **44** and in the lower end of the brace **39**. The upstroke of the tool arm **15** is powered by the flywheel **50**, while the weight of the arm plus the downward force created by the flywheel **50** combine to power the downstroke. Forceful and effective chopping is thus accomplished by the tool **18**.

The axial components of the flywheel's forces, however, result additionally in an axial movement or clawing action for the tool, to produce a truly hoeing motion. This axial movement is permitted by swing of the carriage assembly **37**. Such thrust axial of the tool arm **15**, however, is isolated from the chassis **10** first by the freedom of the carriage assembly **37** to swing in the pedestal bearings **41, 42** (see the motion arrow in Fig. 6). As the carriage assembly rocks back and forth, the springs **46, 47** cushion and limit its movement. The tool arm is shown at the end of its backstroke in Figs. 1 and 2, with the forward spring **46** under tension. The aft spring **47** exerts a similar restraining force on the forward stroke. Little or no vibration axial of the tool arm **15** is imparted to the chassis **10** and handle **30**.

The torsion rod, which forms a part of the carriage **37**, further adds to the floating of the tool arm **15** and isolation of vibrations from the chassis **10**. If the tool **10** should strike a stone or hard patch of ground and be deflected sidewise, the horizontal skewing of the transverse member twists the carriage assembly arms **35, 36** in opposite directions, creating a torsion reaction in the bridge portion **38** of the torsion member. This resilient torsion reaction cushions the deflecting force, yet restrains the deflection and returns the tool arm **15** to its original orientation with respect to the mounting plate **26**.

Because the tool arm **15**, the engine **14**, the drive connections, and the suspension components are all carried by the mounting plate **26**, the horizontal angle at which the tool arm **15** extends from the wheels **11, 12** and axle **20** may be easily adjusted by rotatably setting the position of the mounting plate **26** on the circular plate **24**. With the tool arm **15** extending directly in front of the machine (Fig. 5), it is only necessary to remove temporarily the left wheel **11** and the belt **60**, and to loosen the king bolt **28**, whereupon the mounting plate **26** may be swiveled on the circular plate **24**. Upon retightening of the king bolt **28** and replacement of the belt **60** and wheel **11**, the axle **20** is located behind the belt and the tool **18** extends to work in front of or just outside of the right wheel **12** (Fig. 5). It may thus easily be guided close to and in between plants in rows as the chassis **10** is pushed along such rows.

Turning now to Figs. 7 through 9, the machine there shown as a modified embodiment of the invention is in general similar to that described above. Corresponding parts are identified by the same reference numerals, to which the letter "*a*" has been added. In this arrangement, the mounting plate **26***a* for supporting the engine is rigidly secured on the axle **20***a*. The tool arm **15***a* is suspended from the axle **20***a* by a swinging carriage formed as a U-shaped hinge **70** having upstanding apertured ears **71, 72** journaled on the axle at points spaced

on either side of the mounting plate **26***a*. The hinge **70** has attached or integral on its underside, an axially slotted sleeve **74** disposed transversely of the axle **20***a*. The sleeve **74** receives in axially sliding relation the inner end of the tool arm **15***a*, which carries a transverse pin **75** extending through slots **76** for limiting the range of axial movement and preventing twisting to retain the tool in its depending position. A pair of compression springs **78**, **79** are coaxially disposed on the tool arm at either side of the sleeve **74**, bearing against fixed collars **80**, **81** at their outer ends and against collars **82**, **83** abutting the ends of the sleeve **74**.

Resilient means are provided between the mounting plate and the U-shaped hinge **70** for yieldably stabilizing the vertical swing of the tool arm **15** and to permit elevation of the latter when the handle bar is depressed. These may take the form of a pair of tension springs **85**, **86** secured between points spaced fore and aft on the underside of the mounting plate **26***a* and the horizontal, swinging portion of the U-shaped hinge member **70**. The forward spring **85** is made stronger or stiffer than the aft spring **86** to pick up the tool arm **15***a* and control the elevation of the tool **18***a* when the handle bar **30***a* is depressed. This not only serves to raise the tool **18***a* clear of the ground when the machine is wheeled from one working location to another, but also controls the depth to which the tool chops into the ground.

In this particular embodiment, the spacing pulley **62***a* is journaled on the axle **20***a* rather than on a transverse member, the other structural details being as described in connection with the preferred embodiment.

As the tool arm **15***a* swings vertically under the impetus provided by the eccentric mechanism **16***a*, the hinge **70** rocks about the axle **20***a* with freedom, being cushioned at the extremes of its swing by the respective tension springs **85**, **86**. Under the axial thrusts produced by the eccentric mechanism **16***a*, the tool arm **15***a* also slides axially within the sleeve **74**, resulting in a truly clawing or hoeing motion of the tool **18***a*. Such axial movement is cushioned and substantially absorbed by the compression springs, i. e., by the aft spring **79** on the forward stroke and by the forward spring **78** on the rearward stroke. The axial thrust is thus not transmitted to the chassis and handle bar **30***a* and the machine is easily maneuverable by one man.

I claim as my invention:

1. In a machine of the type described having a wheeled chassis and a power plant thereon, the combination of a tool arm, means mounting said tool arm for both pivotal swing and axial translation relative to said chassis, spring means interposed between said arm and chassis for absorbing axial thrust imparted to said arm, a mass journaled off center on said tool arm at a spaced location from said chassis, means connecting said power plant to rotate said mass to thereby impart orbital motion to said arm, the vertical components of such motion creating a vertical swinging or chopping of said arm relative to the chassis and the component axial of said arm being isolated from the chassis by said absorbing means.

2. In a vibrating machine of the class described having a chassis and a power plant thereon, the combination of an elongated tool arm extending generally horizontally from said chassis, means floatably suspending said tool arm from the chassis to afford vertical swinging movement of the latter about a point near one end thereof and to afford axial translation of the tool arm relative to the chassis, a revoluble eccentric mass mounted on said tool arm and driven by the power plant for imparting orbital movement to said tool arm, and means for absorbing the thrust of such movement along the axis of said tool arm and insolating it from the chassis.

3. In a ground-supported power machine having a chassis and a power plant thereon, the combination of a tool arm, a revoluble eccentric mass mounted on said tool arm and driven by said power plant for imparting orbital motion to said tool arm, means floatably suspending said tool arm from the chassis including a pivotal connection therebetween permitting relative vertical swing of said tool arm, a non-rigid connection between said tool arm and chassis permitting relative axial movement of said tool arm, and means for absorbing such axial movement and substantially isolating it from the chassis.

4. In a vibrating machine of the class described having a chassis and a power plant thereon, the combination of an elongated tool arm, a mass eccentrically mounted on said tool arm and adapted to be driven by the power plant to impart orbital motion to said arm, means suspending said tool arm in substantially horizontally extending relation from said chassis, said suspension means including an element carried by said chassis with freedom for movement relative thereto, said element supporting one end of said arm with freedom for movement relative thereto, one of said movements being a vertical swinging movement and the other being a translation axial of said arm, and resilient means for absorbing the thrust of such translation and isolating it from the chassis.

5. In a machine of the type described having a chassis and a power plant thereon, the combination of a tool arm, a mounting element pivotally carrying said tool arm for swing of the latter in a vertical direction, means pivotally connecting said mounting element to the chassis to give freedom for axial movement of said tool arm, a revoluable eccentric mass on said tool arm and driven by the power plant for imparting orbital motion to said tool arm, and means interposed between said mounting element and the chassis for absorbing the thrust of axial movements of said tool arm and isolating such thrust from the chassis.

6. In a machine of the type described having a chassis and a power plant thereon, the combination with a tool arm of a generally U-shaped mounting element swingingly carried by the chassis, a transverse sleeve fast on said tool arm and pivoted between the jaws of said mounting element to afford relative vertical swing of said tool arm, means driven by the power plant for imparting orbital motion to said tool arm in a vertical plane, and resilient means connected between said sleeve and the chassis to damp the rocking of said mounting element occasioned by the horizontal components of such orbital motion.

7. In a machine of the class described having a chassis and a power plant thereon, the combination of a tool arm extending generally horizontally from said chassis, a revoluble eccentric mass mounted on said arm and driven by the power plant for imparting orbital movement to said tool arm, a swinging carriage pivotally depending from the chassis, means mounting said tool arm in said carriage with freedom for relative movement therebetween along the axis of said tool arm, and means interposed between said carriage and tool arm for absorbing the axial thrust of the latter occasioned by said orbital motion and isolating such thrust from the chassis.

8. In a vibrating power machine having a chassis and a power plant thereon, the combination with a generally horizontal tool arm of a carriage having a sleeve holding said tool arm in relative sliding relation along the axis of the latter, means connecting said carriage to the chassis for vertical swing of the carriage and tool arm about an axis transverse to the axis of the tool arm, a revoluble eccentric mass on said tool arm and driven by the power plant for imparting orbital motion to said tool arm in a vertical plane, and resilient means interposed between said carriage and said tool arm for absorbing axial thrust of said tool arm and isolating it from the chassis.

9. In a machine having a chassis supported by wheels and supporting a power plant, the combination of a tool arm, a carriage member having a sleeve axially slidable between limits on one end of said tool arm, a pair of compression springs mounted coaxially on said tool arm and interposed between collars on the sleeve and tool arm

for cushioning relative axial displacement of the latter, means mounting said carriage on the chassis for relative vertical swing of the carriage and tool arm, and an unbalanced weight near the other end of said tool arm rotatably driven by the power plant to impart orbital motion to the tool arm, the components of such motion axial of said tool arm being cushioned by said springs to render said carriage substantially vibrationless.

10. In a machine of the class described having a chassis and a tool arm extending therefrom adapted to have relative vertical swinging motion, a floating mount for the tool arm comprising, in combination, a mounting element secured to the chassis, means for pivotally securing the tool arm to said mounting element for swinging thereabout in a vertical plane, and means for torsionally stressing said element upon deflection of said tool arm in either direction within a horizontal plane to cushionably retain it in said vertical plane.

11. In a machine of the class described having a chassis and a tool arm extending therefrom adapted to have relative swinging motion, means for mounting the tool arm on the chassis comprising, in combination, a torsion element having a bridge portion secured to the chassis in transverse relation to said tool arm and integral arm portions extending therefrom, means mounting the inner end of said tool arm between said arm portions for free swing in a fixed plane and to be cushionably retained from movements transverse to said plane by torsional stress in said bridge portion.

12. In a machine of the class described having a chassis and a tool arm extending horizontally therefrom adapted to have vertical swinging motion, means for mounting the tool arm on the chassis comprising, in combination, a transverse member fast on one end of said tool arm, a generally U-shaped torsion element having a bridge portion and a pair of spaced arm portions, means for horizontally pivoting said bridge portion on the chassis transverse to said tool arm, said transverse member being pivoted for rotation between said arm portions upon vertical swing of said tool arm, lateral swing of said tool arm being cushioned and restrained by torsional forces created in said bridge portion.

13. In a vibration power machine having a chassis and a power plant thereon, the combination of a tool arm, means mounting said tool arm from the chassis to permit vertical and horizontal swing and axial translation of the former relative to the latter, means driven by the power plant for imparting orbital movement to said tool arm, means for absorbing the thrust of such movement along the axis of said tool arm and isolating it from the chassis, and torsion means for cushioning and restraining any horizontal swing of said tool arm, whereby the latter swings vertically relative to the chassis with no vibration transfer to the chassis.

14. In a machine of the class described having a vertically swingable tool arm, a chassis arrangement comprising, in combination, a ground-supported base, a secondary base rotatably positionable about a vertical axis upon said ground supported base, means securing the tool arm to extend in a substantially fixed direction from said secondary base, a power plant mounted on said secondary base and operatively connected to impart swinging movement to the tool arm in a vertical plane, said tool arm being thereby angularly positionable with respect to said ground supported base upon the positioning of said secondary base.

15. In a machine of the class described, the combination of a pair of ground wheels connected by a horizontal axle, a base member, means mounting said base member horizontally on said axle and with freedom to be angularly adjusted about a vertical axis to said axle, a tool arm suspended from said base and pivotally extending substantially horizontally therefrom, and a power plant fixed to said base and operatively connected to impart vertical swinging to said tool arm, said tool arm being positionable in the angle of its extension relative to said axle upon the rotation of said base relative to said axle.

16. In a cultivating implement having an extending tool arm, a chassis comprising, the combination of a pair of ground wheels and an axle extending between them, a first support base horizontally fixed on said axle, a second support base resting upon said first support base and angularly positionable in a horizontal plane with respect thereto, the tool arm being suspended from said second base in substantially fixed horizontal orientation with respect thereto and swingable in a vertical plane, a power plant fixed on said second base, means driven by said power plant for imparting a vertical swinging motion to the tool arm to cause a tool at the extremity thereof to choppingly engage the ground, the location of such ground engagement being laterally adjustable with respect to said wheels by angularly positioning said second base on said first base.

17. In an earth working machine or the like having a chassis and a power plant thereon, the combination of a tool arm having a transverse member fast on one end, a generally U-shaped torsion element having a bridge portion and a pair of spaced arm portions, means for horizontally pivoting said bridge portion on the chassis, means pivotally connecting said transverse member between said arm portions to afford vertical swing of said tool arm but so that lateral swing of the tool arm is cushioned and restrained by torsional forces created in said bridge portion, and resilient means effectively connected between the chassis and said torsion element to cushion the swinging of the latter relative to the former so that axial vibrations of the tool arm are substantially isolated from the chassis.

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