United States Patent

[11] 3,628,265

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[21] Appl. No. **829,296**
[22] Filed **June 2, 1969**
[45] Patented **Dec. 21, 1971**
Continuation-in-part of application Ser. No. 532,141, Mar. 7, 1966, now abandoned. This application June 2, 1969, Ser. No. 829,296

[54] **OSCILLATING BLADE ASSEMBLY FOR EARTH WORKING MACHINES**
5 Claims, 18 Drawing Figs.

[52] **U.S. Cl.** ..... **37/126 A,** 37/DIG. 18, 172/40, 172/801, 173/49, 299/14
[51] **Int. Cl.** **B60p 1/58,** E02f 3/76
[50] **Field of Search** ..... 37/141, DIG. 18; 299/26, 37, 28; 74/61; 172/40, 101; 173/112

[56] **References Cited**

UNITED STATES PATENTS

2,443,492	6/1948	Austin	37/DIG. 18
2,619,748	12/1952	McIntosh	37/DIG. 18
2,983,322	5/1961	Heeren	172/59 X
3,008,528	11/1961	Berthet et al.	173/112 X
3,033,543	5/1962	Bodine	37/DIG. 18
3,215,209	11/1965	Desvaux et al.	74/61 X
3,339,641	9/1967	Carter	172/40
3,398,798	8/1968	Shelton	172/40 X

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Assistant Examiner—Clifford D. Crowder
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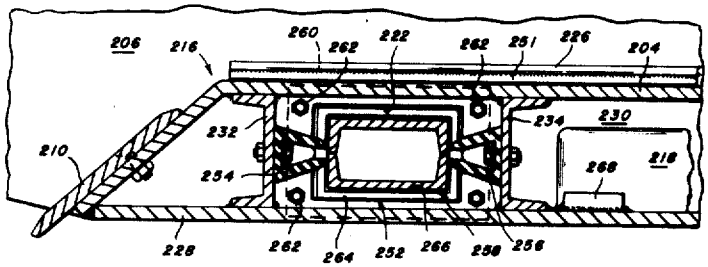
ABSTRACT: An earth working machine blade assembly wherein a separate blade edge is movably mounted on the blade body and is connected to an eccentric weight-type oscillating device. Resilient means are mounted on the machine and connected to the oscillating device to both augment the force exerted by the oscillating device on the blade edge and absorb a portion of the force exerted by the oscillating device on the machine. The oscillating device imparts an oscillatory motion to the blade edge to dislodge earth masses from the ground being worked by the machine.



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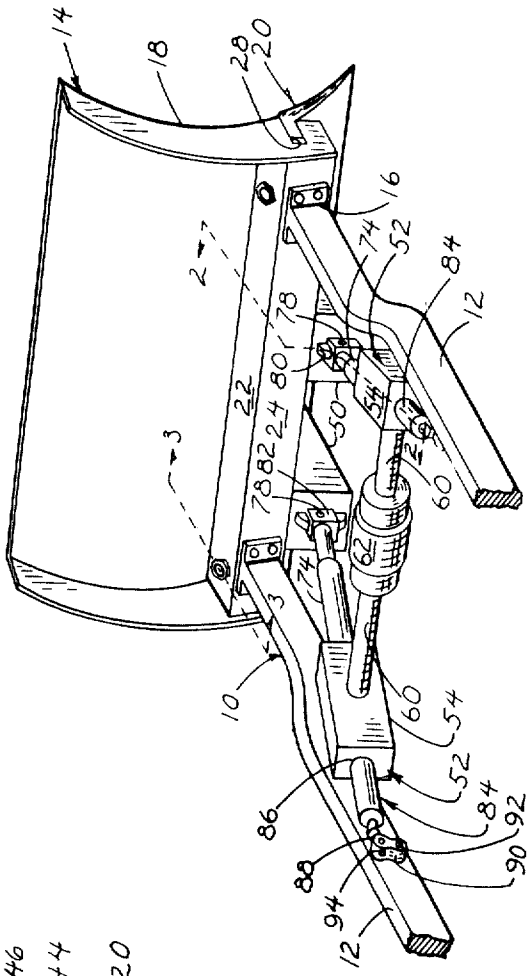

Fig. 1

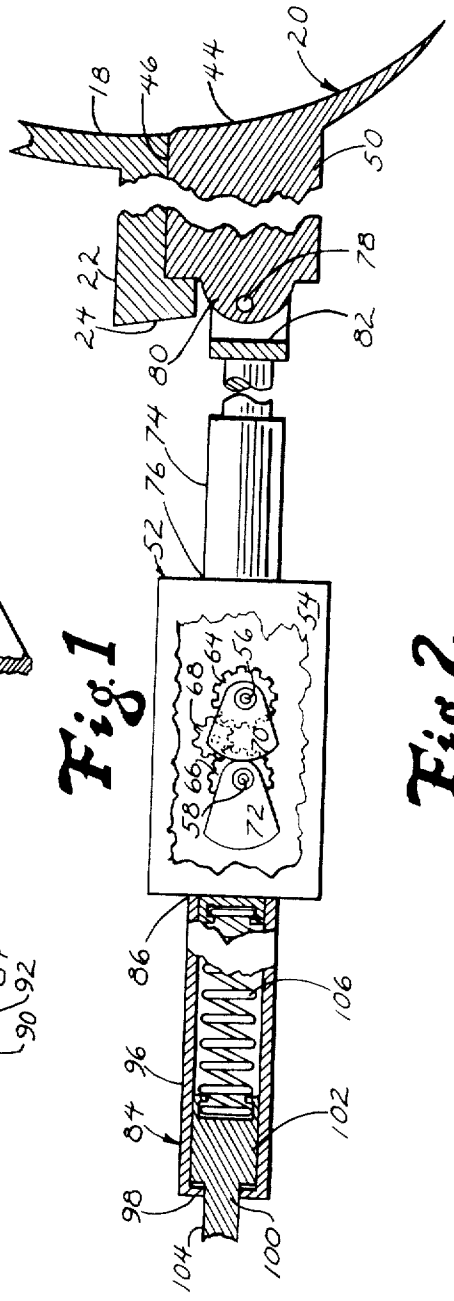

Fig. 2

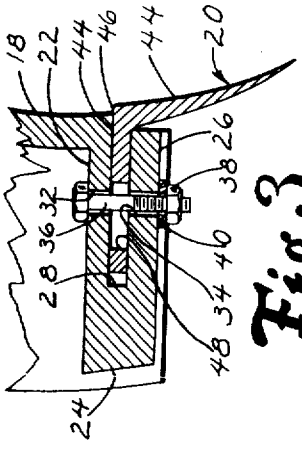

Fig. 3

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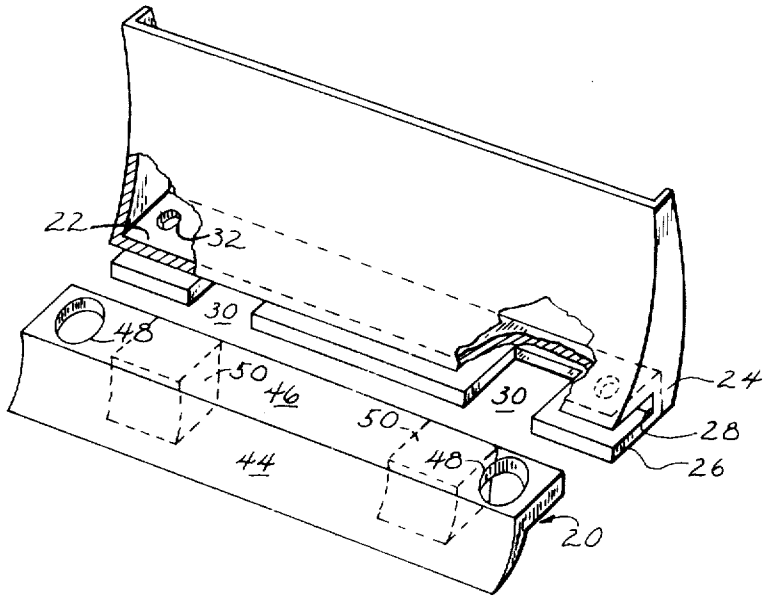

Fig. 4

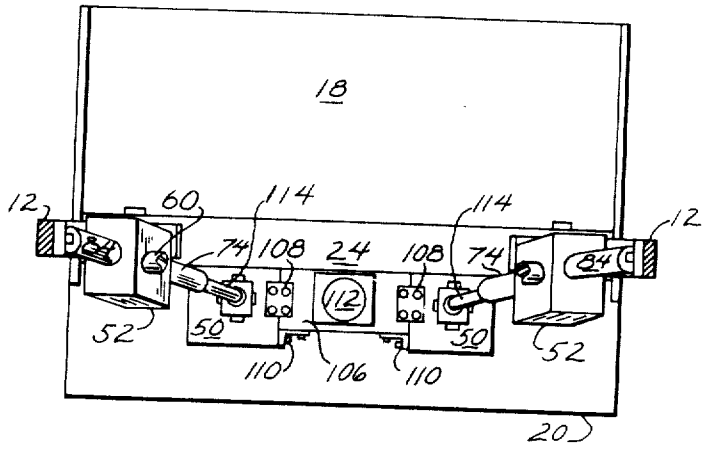

Fig. 5

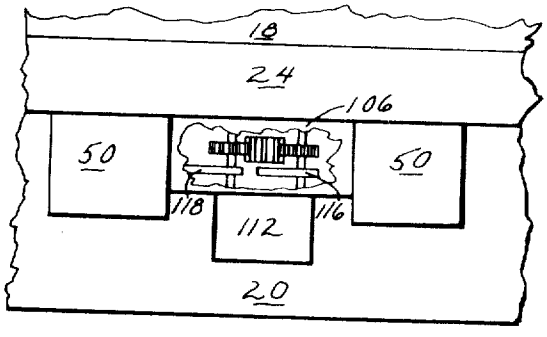

Fig. 10

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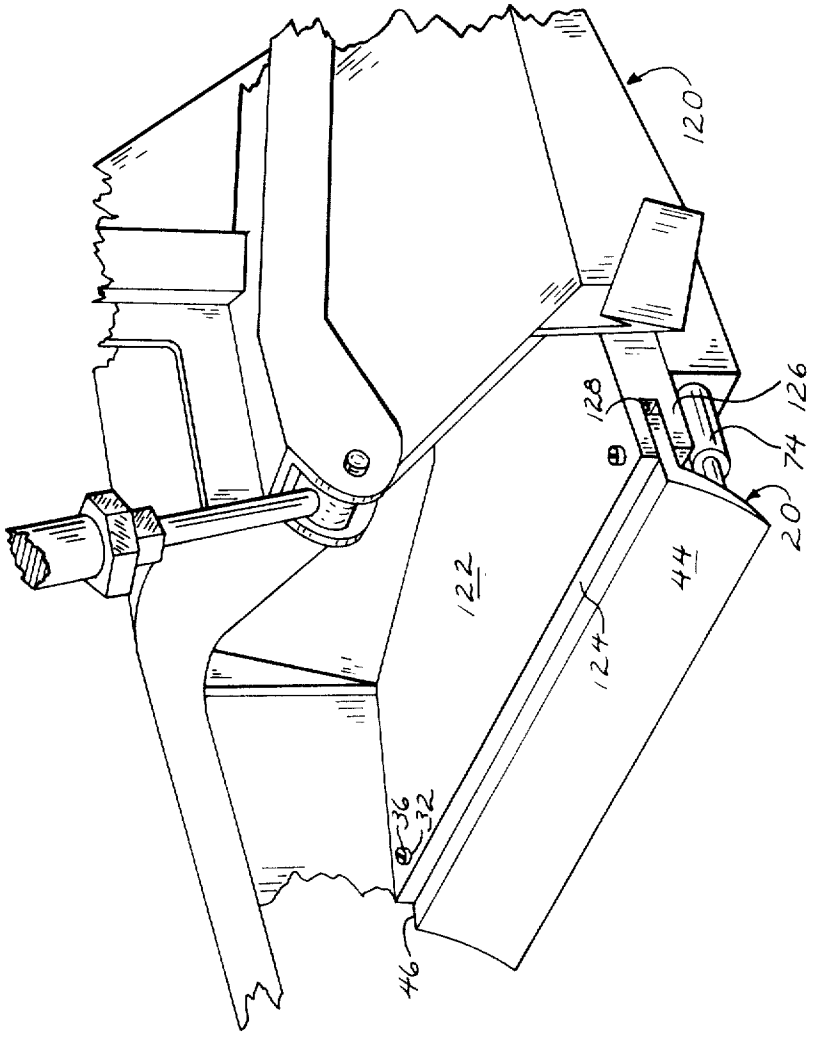

Fig. 6

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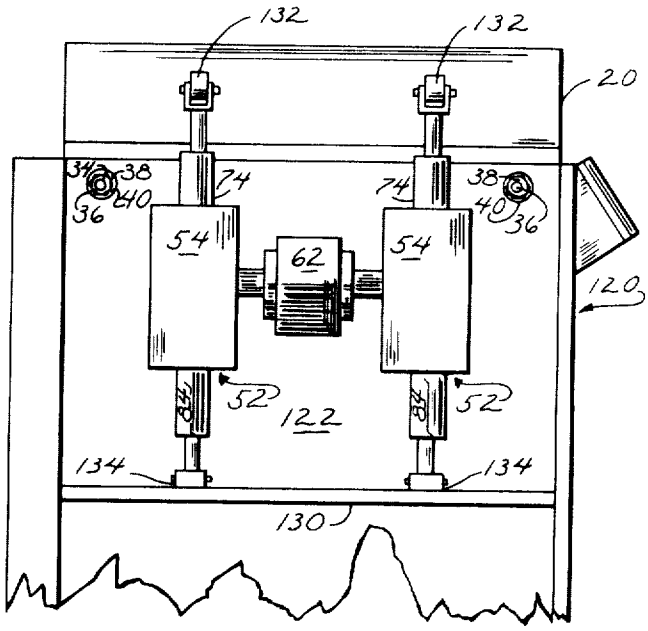

Fig. 7

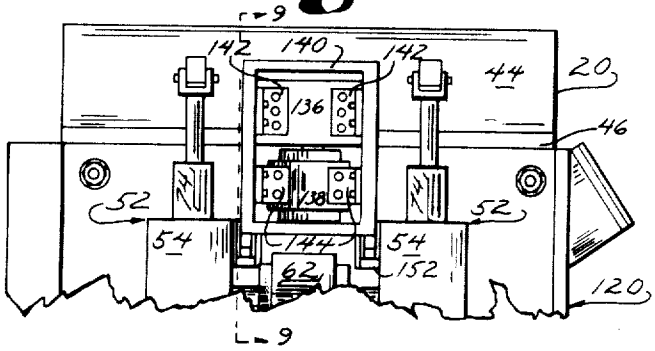

Fig. 8

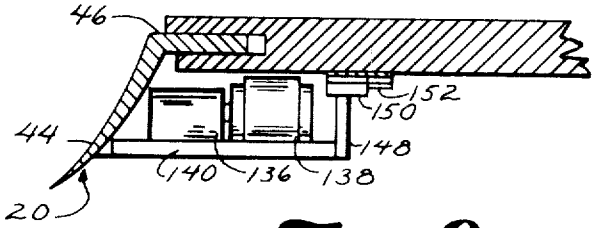

Fig. 9

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FIG. 11

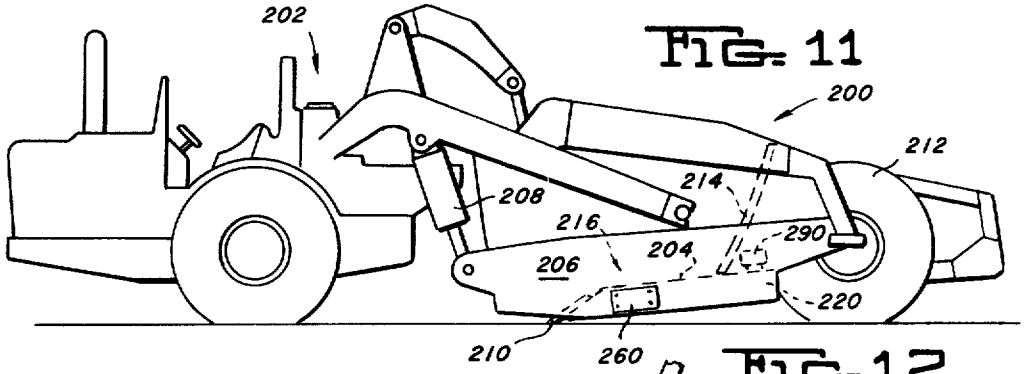

FIG. 12

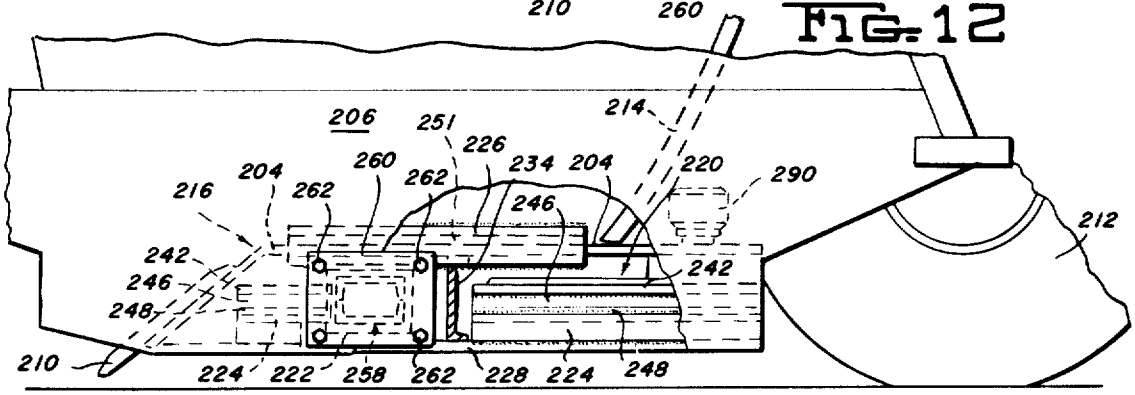

FIG. 13

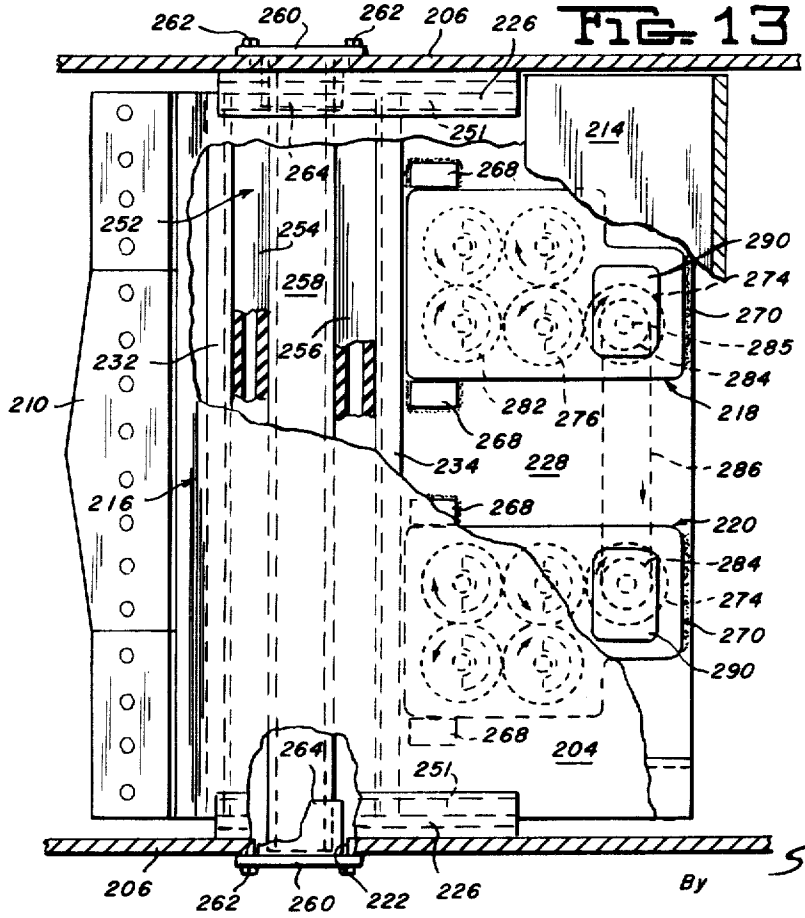

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FIG. 14

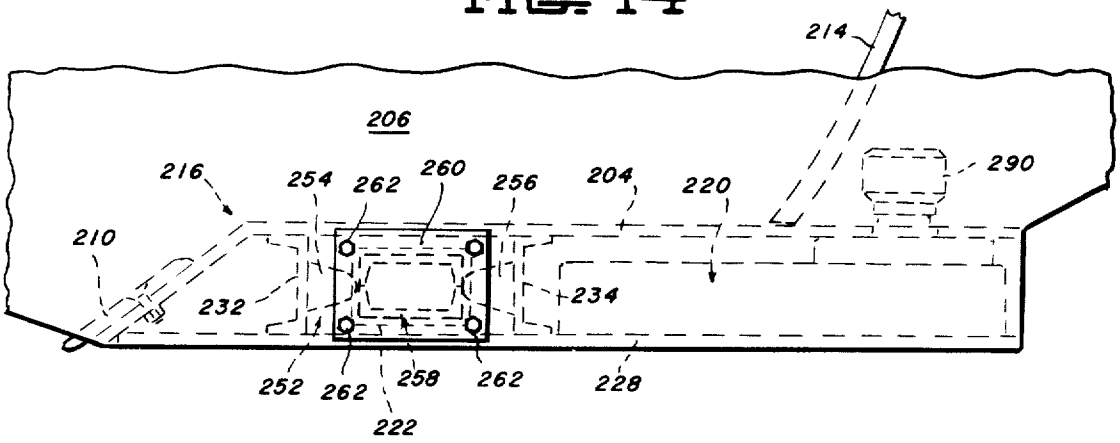

FIG. 15

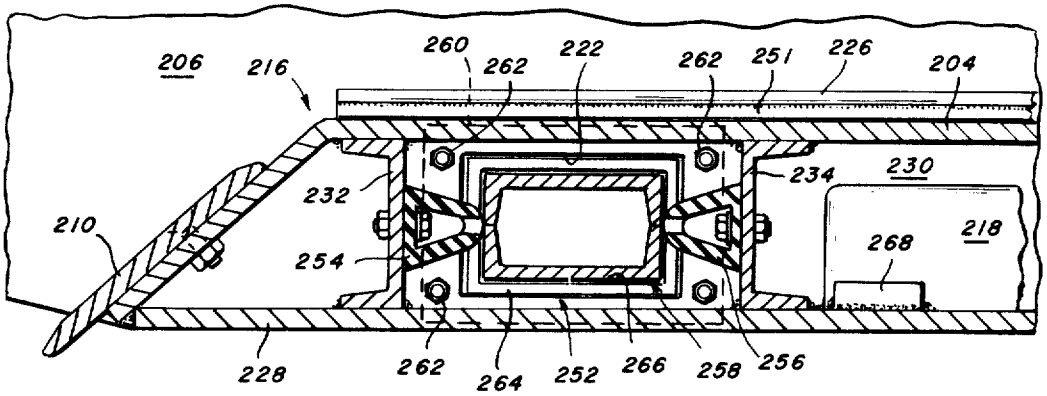

FIG. 16

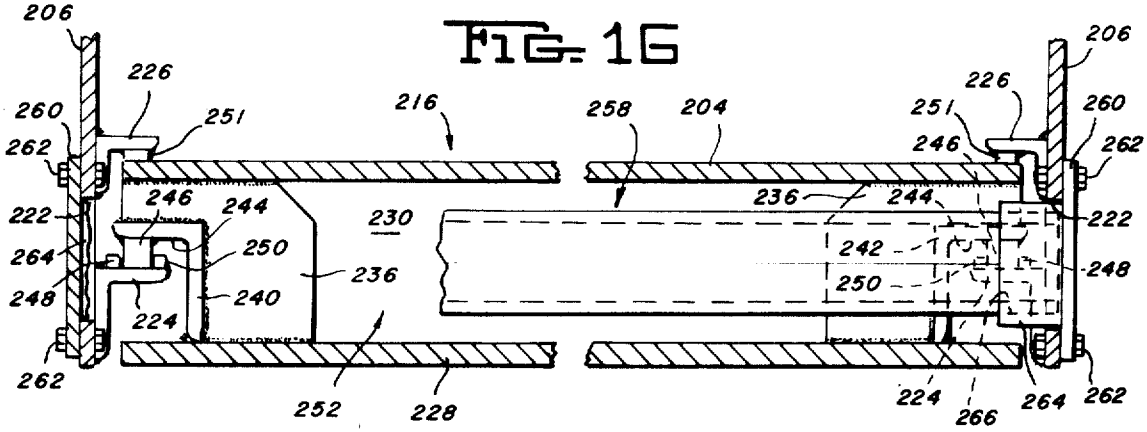

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FIG. 17

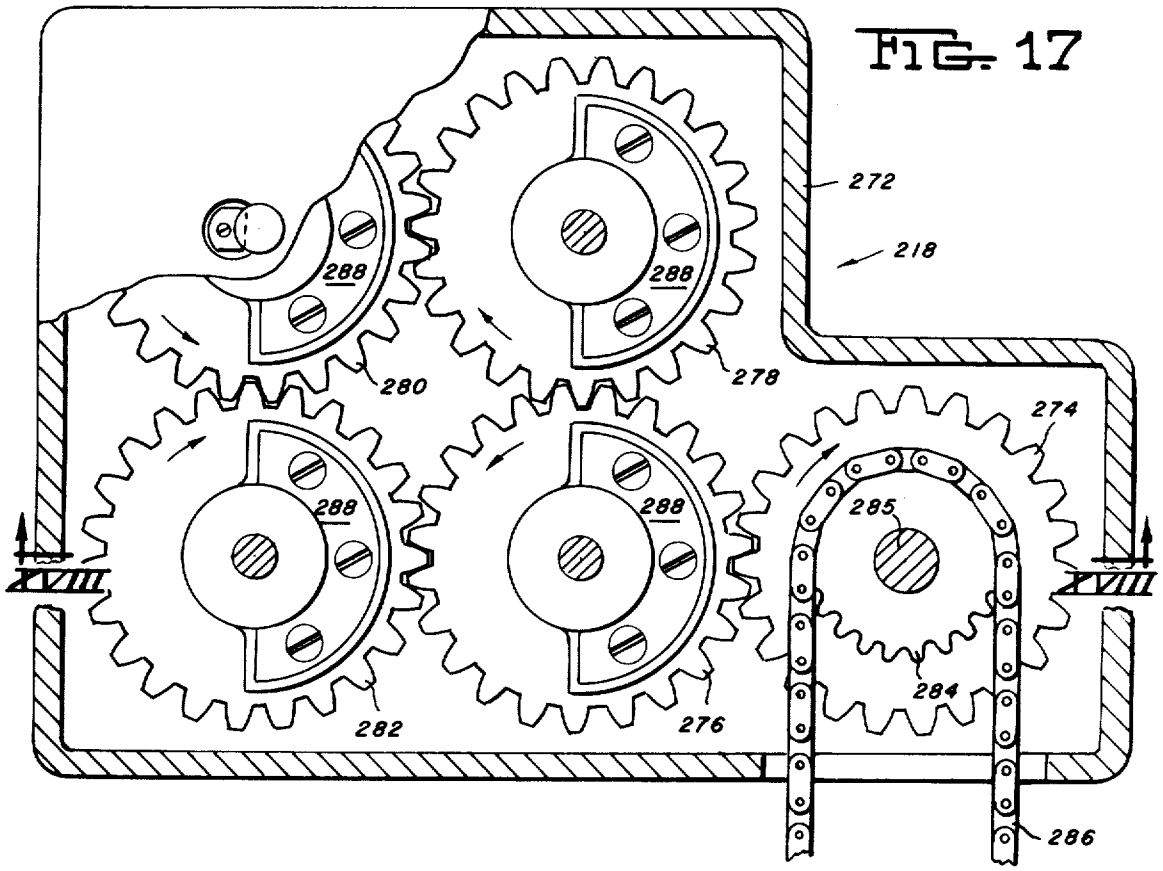
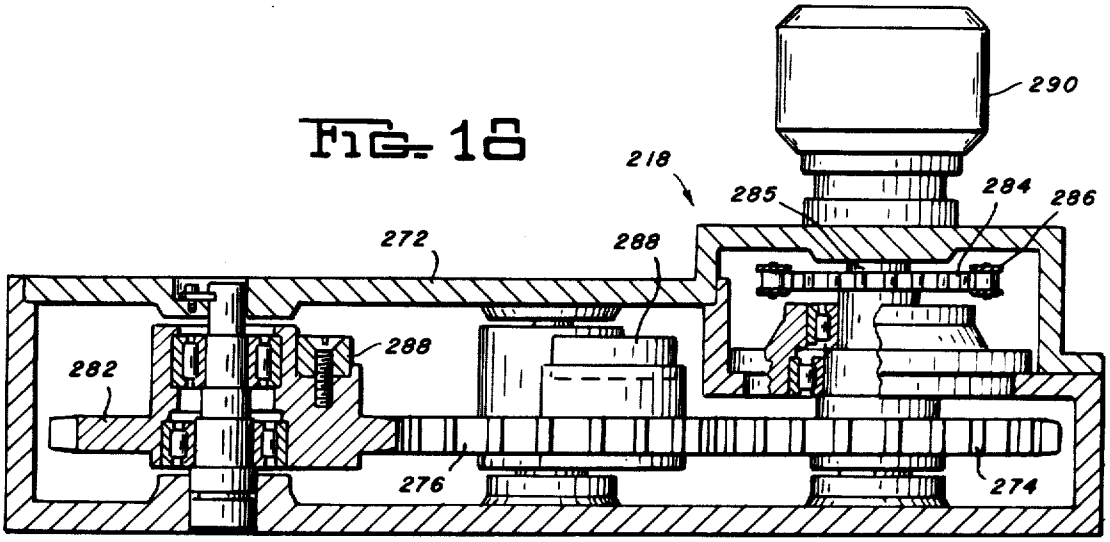


FIG. 18



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OSCILLATING BLADE ASSEMBLY FOR EARTH WORKING MACHINES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of copending application Ser. No. 532,141, filed on Mar. 7, 1966, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to machinery for dislodging, displacing and working earth and similar materials. In particular, this invention concerns an oscillatable blade assembly for use with such earth working machinery.

Earth working machines are generally equipped with a bland constructed and arranged to dislodge and displace the earth being worked by the machine. In those machines having a rigid blade member rigidly secured to the machine, the efficiency of the machine is reduced by stresses imposed upon the machine and the blade while attempting to work large coherent masses of earth and aggregations of such large coherent earth masses. It has been found that the stresses imposed upon the blade and other structural elements of an earth working machine can be reduced and the operating efficiency thereof can be increased, if the working portion of the blade is caused to oscillate relative to the earth mass being worked. Such oscillation of the working portion of the blade breaks the worked earth into smaller particles and dislodges earth masses from the ground being worked by the machine.

An object of this invention is the provision of a blade assembly for earth working machines in which the blade assembly comprises a bland body and a blade edge oscillatable with respect to the blade body.

Another object of this invention is the provision of a blade assembly comprising a blade body and a blade edge oscillatable with respect to the blade body, and including oscillating means operatively connected to the blade edge for oscillation thereof in one direction or in a plurality of directions that can be parallel to or transverse to the longitudinal axis of the earth working machine or can oscillate the blade edge in more complex patterns which are other than merely transverse to or parallel to the longitudinal axis of the earth working machine.

Still another object of this invention is the provision of an earth working machine blade assembly comprising a blade body and a blade edge and oscillating means operatively connected to the blade edge for oscillation thereof wherein the oscillating means comprises a plurality of oscillators operable separately or simultaneously, either in synchronization with each other or in any phase relationship among the individual oscillators.

An additional object of this invention is the provision of an earth working machine blade assembly having an oscillatable blade edge, and having oscillating means controllable and adjustable to provide thrusts of a magnitude selected from a wide range of attainable magnitudes and capable of imparting to the blade edge oscillatory movements having a displacement selected from a wide range of attainable displacements.

Another object of this invention is the provision of an earth working machine having an oscillatable blade edge, oscillating means to oscillate the blade edge, and resilient means capable of absorbing, at least partially, the shocks and stresses imparted to the blade assembly and earth working machine during oscillation of the blade edge and capable of augmenting the thrust imparted to the blade edge by the oscillating means.

Other objects of this invention will become apparent in light of the following discussion and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an isometric rear view of an oscillatable blade assembly constructed and arranged for use with a bulldozer, a plow or a similar earth working machine.

FIG. 2 is a side view, partially in cross section and partially fragmented, taken along the line 2—2, of the apparatus illustrated in FIG. 1.

FIG. 3 is an enlarged fragmented view, partially in cross section, of the connecting means securing the blade edge oscillatably on the blade body.

FIG. 4 is an exploded isometric view, partially fragmented and partially in section, of a blade comprising part of this invention.

FIG. 5 is an isometric rear view of an embodiment of this invention having a plurality of oscillators constructed and arranged to impart to the blade edge both oscillations parallel to the longitudinal axis of the earth working machine and oscillations transverse to the longitudinal axis of the earth working machine.

FIG. 6 is an isometric view of an embodiment of the oscillatable blade assembly of this invention incorporated in an earth working machine such as a scraper, grader or plow.

FIG. 7 is a bottom plane view of apparatus such as that illustrated in FIG. 6 having a plurality of oscillators constructed and arranged to oscillate the blade edge in directions that are substantially parallel to the longitudinal axis of the earth working machine.

FIG. 8 is a bottom plan view of the apparatus shown in FIGS. 6 and 7 and having a plurality of oscillators constructed and arranged to impart to the blade edge oscillatory motions that are parallel and transverse to the longitudinal axis of the machine, as well as motions which are neither strictly parallel nor strictly transverse to the longitudinal axis of the machine.

FIG. 9 is a side elevation, partially in cross section, of means shown in FIG. 8 for securing an oscillator and drive means to the blade edge.

FIG. 10 is a rear elevation, partially fragmented, of a blade assembly such as that shown in FIG. 5 but modified to obtain oscillation of the blade edge about a closed curve path while using a single oscillator.

FIG. 11 is a view in side elevation of a tractor scraper with another embodiment of an oscillatable deck and blade assembly mounted thereon.

FIG. 12 is an enlarged view of the tractor scraper bucket with portions of the sideplate broken away to illustrate the manner in which the oscillatable deck and blade assembly is mounted thereon.

FIG. 13 is a top plan view of the bucket portion of the bottom deck broken away to illustrate the oscillators secured to the deck and blade assembly.

FIG. 14 is a view similar to FIG. 12 illustrating the resilient means between the cross member secured to the bucket sideplates and the oscillatable blade-deck assembly.

FIG. 15 is a view similar to FIG. 14 with the sideplate removed.

FIG. 16 is a view in section and in elevation illustrating the side guide members secured to the bucket sideplates and slidably supporting the deck-blade assembly.

FIG. 17 is a top plan view of an oscillating device with the top cover removed and illustrating the plurality of eccentric weights geared to each other.

FIG. 18 is a view in elevation and section taken along the line 18—18 in FIG. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As used herein, the following terms have the meanings set forth below:

The term "earth working machine" includes bulldozers, scrapers, graders, highlifts, snow plows and the like.

The term "earth" includes not only soil and the like but also includes, for convenience and simplicity of description, such materials as sand, gravel, slag and other road bed materials; minerals such as coal and mineral ores that can be mined with earth working machines; snow, and all other materials that can be dislodged and displaced with earth working machines.

The terms "oscillate" and "oscillatable" are used herein to express the concept of relative motion between parts of the blade assembly, such as the blade edge and the blade body, or relative motion between the blade edge and the material being worked. Those terms are used to describe motion in all

directions and patterns, whether such motion is parallel or transverse to the longitudinal axis of the earth working machine or whether the motion described is a complex motion resulting from a combination of motions which are transverse or parallel to the longitudinal axis of the machine, with or without the combination of motion that is neither transverse nor parallel to the longitudinal axis of the machine.

As broadly defined, this invention resides in a blade assembly for use with earth working machines comprising a blade body; a blade edge mounted on the blade body and oscillatable with respect thereto; oscillating means operatively connected to the blade edge to move the blade edge along its paths of oscillation; and drive means connected to the oscillating means for actuation thereof. One embodiment of the apparatus of this invention includes connecting means securing the blade edge on the blade body and constructed and arranged such that the blade edge is oscillatable with respect to the blade body. A second embodiment of the apparatus of this invention has resilient means connected to the oscillating means to augment the force exerted by the oscillating means while moving the blade edge in one direction and to reduce the force exerted by the oscillating means against the machine while moving the blade edge in the opposite direction. Other embodiments of this invention are described in the following discussion in conjunction with the accompanying drawings.

An embodiment of the apparatus of this invention suitable for use, for example, with a bulldozer of highlift or plow, is illustrated in FIGS. **1** through **5**. In FIG. **1** there is shown a blade assembly, indicated generally by reference numeral **10** having a pair of spaced parallel support arms **12**, for mounting the blade assembly **10** on an earth working machine (not shown in the drawings). A blade, indicated generally by reference numeral **14**, is connected at **16** to the ends of support arms **12** by any suitable connecting means. Blade **14** has a blade body **18** and a blade edge, indicated generally by reference numeral **20**.

As is shown in FIGS. **1**, **3** and **4**, blade body **18** has extending outwardly from the lower end thereof an upper flange **22**. A stop member **24** extends downwardly from the edge of upper flange **22** remote from blade body **18**. A lower flange **26** is integral with the lower end of stop member **24** and extends outwardly therefrom beneath and spaced from upper flange **22**. Upper flange **22** and lower flange **26** form therebetween a channel **28**. As shown in FIG. **4**, a lower flange **26** has a pair of openings **30** therein extending from the front of flange **26** rearwardly toward stop member **24**. Upper flange **22** has a plurality of holes **32** extending therethrough and aligned with a plurality of similar holes **34** extending through lower flange **26** (FIG. **3**).

The configuration and dimensions of holes **32** and **34** are such that the shaft of a bolt **36** extending through holes **32** and **34** and upper flange **22** and lower flange **26** remains stationary relative to flanges **22** and **26**. Bolt **36** is secured to flanges **22** and **26** by lock nut **38** and lock washer **40**. In lieu of bolt **36**, nut **38** and washer **40**, another connecting means can be employed with the apparatus of this invention as long as that connecting means provides a rigid connecting member extending through channel **28** between flanges **22** and **26**. The use of that rigid connecting member is explained more fully below.

Blade edge **20** has a downwardly extending front member **44** constructed and arranged for dislodgement and displacement of earth or other material to be worked. A connecting flange **46** is integral with the upper edge of front member **44** and extends rearwardly therefrom. Connecting flange **46** of blade edge **20** is adapted to fit loosely in channel **28** between upper flange **22** and lower flange **26** of blade body **18**. A plurality of apertures **48** extend through connecting flange **46** and are positioned on connecting flange **46** to be aligned with holes **32** and **34** in upper flange **22** and lower flange **26**, respectively.

It is desirable to incorporate in the apparatus of this invention means of simple and rugged construction for connecting blade edge **20** oscillatably on blade body **18**. One embodiment of such connecting means that is suitable for use with the apparatus of this invention is shown in FIGS. **3** and **4**. Blade edge **20** is assembled on blade body **18** in the channel **28** with apertures **48** aligned with holes **32** in upper flange **22** and holes **34** in lower flange **26**. The diameter of holes **32** and **34** preferably are just slightly larger than the diameter of the shaft of the bolt **36**, and bolt **36** is rigidly secured in flanges **22** and **26** by tightening lock washer **40** and nut **38** on bolt **36** against the surface of lower flange **26**. It is preferred that apertures **48** have a substantially circular configuration with a diameter larger than the shaft of bolt **36**.

With regard to the construction and operation of the connecting means as shown in FIGS. **3** and **4**, it should be noted that the total displacement imparted to blade edge **20** is generally within the range of from about a fraction of 1 inch to about 3 inches, and preferably is restricted to small displacements of up to about ¾ inch to about 1 inch. Shearing stresses imposed upon bolt **36** can be minimized if the diameter of aperture **48** is sufficiently large to permit oscillation in any direction in a plane perpendicular to the longitudinal axis through bolt **36** while preventing entirely or minimizing contact between the shaft of bolt **36** and the surface of connecting flange **46** surrounding aperture **48**. Furthermore, shearing stresses imposed upon the shaft of bolt **36** can be eliminated or substantially reduced by providing suitably small clearances between the upper and lower surfaces of connecting flange **46** and the adjacent surfaces of upper flange **22** and lower flange **26** on blade body **18**. By providing small clearances between connecting flange **46** and flanges **22** and **26**, the motion of blade edge **20** in channel **28** is restricted to a sliding motion substantially parallel to the adjacent surfaces of flanges **22** and **26**, with little or no torsional stress applied to the shaft of bolt **36** in the event that contact is made between the shaft of bolt **36** and the surface of connecting flange **46** surrounding aperture **48**.

In FIGS. **1** and **2** there are shown a pair of connecting bars **50** integral with and extending downwardly from connecting flange **46** of blade edge **20**. Connecting bars **50** are constructed and arranged to fit loosely in openings **30** of lower flange **26** with the dimensions of connecting bars **50** and openings **30** being such that there is little or no impairment of the oscillation of blade edge **20** on blade body **18** arising from excessive contact between the surfaces of connecting bars **50** and the surfaces of lower flange **26** around openings **30**.

Inherent in the concept of this invention is the inclusion in the structure of blade assembly **10** of oscillating means constructed and arranged to move blade edge **20** in a desired path of oscillation. An oscillating means is suitable for use with the apparatus of this invention if it is capable of imparting to blade edge **20** oscillations having displacements substantially within the range of suitable magnitude of displacement discussed above. It is desirable that the oscillating means be of simple and rugged construction, and it is preferred that the oscillating means be capable of developing linearly directed thrusts alternately in opposite directions. It is also preferred that the magnitude of the thrust forces developed by the oscillating means be controllable and variable over a desired range.

One embodiment of oscillating means suitable for use with this invention is shown in FIGS. **1** and **2** and comprises an oscillator, indicated generally by reference numeral **52**, having a housing **54**. Oscillator **52** has a drive shaft **56** and a second shaft **58** rotatably secured between the sidewalls of housing **54** in spaced parallel relation with each other. Drive shaft **56** extends through one sidewall of housing **54** and is operatively connected by suitable means, such as connecting shaft **60**, to suitable drive means such as motor **62**. Motor **62** can be driven either electrically or hydraulically and can be independently operable or can be operatively connected to the electrical system or the hydraulic system of the earth working machine upon which blade assembly **10** is mounted. The type of drive means, such as motor **62**, employed to actuate the oscillating means is not a critical aspect of the apparatus of this invention, and any drive means capable of actuating the

particular oscillating means employed is, therefore, suitable for use with this invention.

In the oscillating means as shown in FIG. 2, a gear train is operatively connected to shafts 56 and 58 for operation of the shafts in any particular phase relationship. FIG. 2 shows a drive gear 64 mounted on drive shaft 56 and a driven gear 66 mounted on second shaft 58. Drive gear 64 and driven gear 66 are operatively connected in meshed engagement with an idler gear 68 mounted on a sidewall of housing 54. Weights 70 and 72 are eccentrically mounted, in spaced relation with each other, on shafts 56 and 58, respectively, and are suitably arranged to provide the desired thrust forces. As shown in FIG. 2, oscillator 52 has the structural elements thereof constructed and arranged so that eccentric weights 70 and 72 operate in phase in the sense that the longitudinal axes of weights 70 and 72, extending from the center of the shaft to which the weight is connected to the perimeter of the larger arcuate surface of the particular weight, are always parallel and projecting in the same direction during the operation of oscillator 52. Such arrangement and operation of the eccentric weights is adapted to provide maximum thrust in a given direction.

It should be noted that many possible modifications of the construction and arrangement of oscillator 52 are within the purview of the concept of the invention described herein. For example, one weight or more than two weights, can be used depending upon the type of oscillator 52 employed and the desired magnitude of the thrust. In addition, other types of gear trains can be employed for the operative connection between the oscillator shafts, and the gear train can be modified to provide for rotation of the shafts in opposite directions instead of in the same direction as discussed above. Furthermore, it might be desirable to have motor 62 connected to a drive shaft that is directly connected to an element of the gear train such as idler gear 68 while shafts 56 and 58 both function as driven shafts. Whatever the construction of the oscillator, it is preferred that the oscillator be adjustable to operate in any phase relationship in order that the direction and magnitude of the thrust developed by the oscillator can be controlled and regulated.

In assembly on the earth working machine, the oscillating means is connected to blade edge 20 by means such as those shown in FIGS. 1 and 2 comprising a rigid connecting rod 74 consisting of suitable means such as a bar or pipe. Connecting rod 74 has one end rigidly connected at 76 to oscillator housing 54. The other end of connecting rod 74 is connected at 78 to blade edge 20. As shown in FIG. 2, connection 78 comprises a pivotal connection between an ear 80 extending outwardly from connecting bar 50 and a yoke 82 extending from the end of connecting rod 74 to engage ear 80. Alternatively to the pivotal connection shown at 78 in FIG. 2, the connection 78 can comprise other types of connections such as a ball joint or a rigid connection, depending upon the type of oscillatory motion desired and upon the mode of mounting oscillator 52 on the earth working machine. Other suitable types of connections 78 are discussed more fully below.

The end of oscillator 52 remote from blade edge 20 is connected to the earth working machine by means such as those shown in FIGS. 1 and 2 comprising an oscillator connector, indicated generally by reference numeral 84, having one end rigidly connected at 86 to housing 54 of oscillator 52 and the other end suitably connected at 88 to the earth working machine by means such as those shown in FIG. 1 comprising a link 90 having one end pivotally connected at 92 to support arm 12 of the earth working machine and having the other end pivotally connected at 94 to the end of oscillator connector 84. Connection 88 between oscillator connector 84 and the earth working machine can comprise virtually any other type of connecting means such as a ball joint or a rigid connection that is amenable to use with the directions and magnitudes of thrust to be employed.

In certain embodiments of the apparatus of this invention oscillator connector 84 can comprise a rigid solid bar or hollow tube or pipe similar to that employed for use as connecting rod 74. However, in other embodiments of this invention, it is preferred that oscillator connector 84 consist of resilient means such as that shown in FIG. 2 comprising a cylinder 96 rigidly connected at 86 to housing 54 of oscillator 52 and having at its other end a closure member 98 with an opening 100 extending therethrough. A piston 102 is slidably enclosed within cylinder 96 and has a piston rod 104 extending from one end of piston 102 and slidably secured in opening 100 of closure member 98. The end of piston rod 104 remote from piston 102 is connected at 88 to the earth working machine. A helical spring 106 is secured at one end to the inner wall of cylinder 96 adjacent oscillator 52 and is secured at its other end to piston 102.

As can be seen from inspection of FIG. 2, the resilient means comprising oscillator connector 84 functions in cooperation with oscillator 52, such that, when weights 70 and 72 are in the positions indicated in FIGS. 2, cylinder 96 slides rearwardly along piston rod 104 toward the earth working machine, thereby compressing spring 106. Because of the force dissipated in compression spring 106, the magnitude of the force imparted to the earth working machine on the rearward stroke of oscillator 52 is reduced by the resilient oscillator connector 84. Alternatively, on the forward stroke of oscillator 52; that is, when weights 70 and 72 are displaced 180° from the positions shown in FIG. 2, cylinder 96 slides forwardly along piston rod 104 toward blade edge 20 and spring 106 expands, thereby exerting upon oscillator 52 a thrust that increases the magnitude of the forward thrust delivered to blade edge 20. In lieu of the spring-loaded resilient means shown in FIG. 2, other resilient means, such as pneumatically or hydraulically actuated resilient means, can be employed with the apparatus of this invention.

FIG. 1 shows blade assembly 10 having oscillating means comprising a pair of oscillators 52, each operatively connected to a single drive means such as motor 62 and each operatively connected to one of a pair of connecting bars 50 on blade edge 20. Either or both of oscillators 52 can be adjustable and the oscillators can be operated either individually or simultaneously and can also be actuated either synchronously or asynchronously. With the structural arrangement shown in FIG. 1, if oscillators 52 are operated synchronously in substantially identical phase, blade edge 20 is oscillated longitudinally of blade assembly 10 and the earth working machine with the blade edge 20 moving alternatively forwardly and rearwardly of blade body 18. However, if oscillators 52 are actuated asynchronously or in different phases, the motion imparted to blade edge 20 comprises a series of oscillations with one end of blade edge 20 moving forwardly of blade body 18 while the other end of blade edge 20 is moving rearwardly of blade body 18, and vice versa.

Many modifications of the structural combination comprising the oscillating means and blade edge can be employed within the concept of this invention. For example, a single oscillator 52 can be mounted on the earth working machine and connected to one of the connecting arms 50 of blade edge 20 to oscillate the blade edge. Alternatively, a single oscillator 52 can be supported on the earth working machine intermediate support arms 12 with the drive means operatively connected to oscillator 52 and with oscillator connected to a single connecting bar 50 positioned intermediate the ends of blade edge 20, thereby imparting to the blade edge a series of straight linear oscillations substantially parallel to the longitudinal axis of the earth working machine. In another embodiment of this invention, a single oscillator 52 can be mounted between the pair of connecting bars 50 on blade edge 20 with weights 70 and 72 rotatable in vertical planes that are substantially perpendicular to the surface of blade edge 20, thereby imparting to blade edge 20 a series of oscillations substantially parallel to the longitudinal axis through earth working machine. In an additional embodiment of this invention, a single oscillator 52 can be mounted between a pair of connecting bars 50, or otherwise operatively connected to blade edge 20,

with weights 70 and 72 rotatable in planes that are perpendicular to the longitudinal axis of the earth working machine thereby imparting to blade edge 20 a series of lateral oscillations that are perpendicular to the longitudinal axis of the earth working machine.

Other embodiments of the apparatus of this invention are shown in FIGS. 5 and 10, wherein structural elements identical to those shown in FIGS. 1 and 2 are indicated by the reference numerals used in FIGS. 1 and 2. For example, in FIG. 5, there is shown oscillating means comprising a combination of oscillators 52 as shown in FIG. 1 with a third oscillator 106 mounted between connecting bars 50, and connected thereto by suitable connecting means such as mounting plates 108 and mounting brackets 110, all of which are mutually connected to oscillator 106 and connecting bar 50 by bolts, pins, rivets, or other suitable fasteners. Motor 62 is not shown in FIG. 5 for purposes of clarity, and a second motor 112 is shown operatively mounted on oscillator 106 for actuation thereof.

Oscillator 106 can be connected to blade edge 20 with the weights of oscillator 106 rotatable in vertical planes parallel to the longitudinal axis of earth working machine. With that arrangement of oscillators 52 and 106, blade edge 20 would be oscillated rearwardly and forwardly of blade body 18, following an oscillatory pattern determined by the operating phase relationships among oscillators 52 and 106. Alternatively, oscillator 106 can be mounted with its weights rotatable in vertical planes perpendicular to the longitudinal axis through earth working machine. With that construction, oscillators 52 and 106 can be operated in phase relationships such that blade 20 is oscillated forwardly and rearwardly of blade body 18 by oscillators 52 and is oscillated laterally of blade body 18 by oscillator 106. In that instance, the resultant path of oscillation traversed by blade edge 20 can be adjusted to a closed curve such as a circular path or an elliptical path. It should be noted that when such complex paths of oscillation are imposed upon blade edge 20, it is often desirable to substitute, for the pivotal connection shown at 78 in FIG. 1, a ball joint connection such as that shown at 114 in FIG. 5.

If oscillators 52 are omitted from the structure shown in FIG. 5, there remains an embodiment of the blade assembly employing a single oscillator 106, one possible mode of operation of which was discussed above. In an apparatus employing a single oscillator 106 as shown in FIG. 5, a closed curve path of oscillation of blade edge 20, such as a circular or an elliptical path, can be imposed upon blade edge 20 if the orientation of oscillator 106 is modified as shown in fig. 10. In that embodiment, oscillator 106 is mounted on blade edge 20 and the shafts contained in the oscillator 106 arranged perpendicular to upper flange 22 and lower flange 26 of blade body 18 and with the weights 116 and 118 of oscillator 106 rotatable in planes parallel to the planes of upper flange 22 and lower flange 26 on blade body 18. As weights 116 and 118 are moved into projection toward either of mounting bars 50, blade edge 20 is oscillated laterally of blade body 18 and as weights 116 and 118 are moved into projection toward blade edge 20 or rearwardly away from blade edge 20, the blade edge is oscillated rearwardly and forwardly on blade body 18. It can be seen also that, with such construction, the continuous rotation of weights 116 and 118 can move blade edge 20 along a closed curve path such as a circular path or an elliptical path.

Another embodiment of the blade assembly of this invention, which is suitable for use in combination with road graders, scrapers, plows and other such machines is shown in FIGS. 6 through 9. In FIG. 6, there is shown an oscillatable blade edge 20 mounted on the scraper indicated generally by reference numeral 120 Scraper 120 comprises a deck member 122 having at the front end thereof an upper flange 124 and a lower flange 126 extending outwardly from deck 122 in spaced parallel relation with each other. A channel 128 formed between flanges 124 and 126 is constructed and arranged to receive connecting flange 46 of blade edge 20. Blade edge 20 used with scraper 120 can be identical in construction with blade edge 20 employed on blade assembly 10 shown in FIG. 1. The arrangement of the oscillating means and drive means employed with blade edge 20 on scraper 120 is illustrated in FIG. 7, showing a bottom plan view of the scraper 120 shown in FIG. 6. Connecting means employed to secure blade edge 20 oscillatably to blade body 18. The connecting means comprises a bolt 36 extending through holes 32 in upper flange 124 of deck 122 and through holes 34 of lower flange 126 with holes 32 and 34 aligned with each other.

Bolt 36 is rigidly secured in holes 32 and 34 by washer 38 and lock nut 40 which are tightened on the shaft or bolt 36 against the undersurface of lower flange 126, as shown in FIG. 7. Blade edge 20 is mounted on deck 122 with connecting flange 46 of blade edge 20 loosely fitting in channel 128 and with the shafts of bolts 136 extending through enlarged apertures 48 as shown in FIG. 4, adapted to permit oscillation of blade edge 20 about the shafts of bolts 36.

The underside of scraper 120 has a transverse bridge member 130 contiguous to the underside of deck 122. The oscillating means and drive means employed with the apparatus of FIGS. 6 and 7 are identical with the means employed with blade assembly 10 as shown in FIG. 1 and comprise oscillators 52 and motor 62 which are connected, through connecting rods 74 to blade edge 20 at 132. The connection 132 between connecting rod 74 and blade edge 20 is shown as a pivotal connection; however, a rigid or a ball joint connection also can be suitable for use with the embodiment of the invention shown in FIGS. 6 and 7. Each oscillator 52 is secured at connection 134 to bridge member 130 by oscillator connector 84. Oscillator connector 84 can be a rigid connecting member of can comprise resilient means such as those described above suitable for use with blade assembly 10 shown in FIGS. 1 and 2.

FIG. 8 shows an embodiment of this invention wherein three oscillators are employed to oscillate blade edge 20 and are constructed and arranged in a manner similar to that shown in FIG. 5. A pair of oscillators 52 are mounted as was shown in FIG. 7 and driven by motor 62 connected to both of oscillators 52. A third oscillator 136 is driven by a motor 138 with oscillator 136 and motor 138 suitably operatively mounted on blade edge 20 by mounting brackets as shown in FIGS. 8 and 9.

The mounting means shown in FIGS. 8 and 9 comprises a mounting frame 140 rigidly connected to the undersurface of front member 44 of blade edge 20 and consisting of a square or rectangular frame. As is shown in FIG. 9, mounting frame 140 extends rearwardly from front member 44 of blade edge 20 vertically spaced from the undersurface of flange 126 of bed 122. Oscillator 136 is connected to frame 140 by suitable means such as connecting flanges 142 with the upper surface of oscillator 136 spaced from the undersurface of lower flange 126. Motor 138 is also connected to frame 140 by suitable means such as connecting flanges 144, with the upper surface of motor 138 spaced from the undersurface of lower flange 126.

Each rear corner of mounting plate 140 has integral therewith and extending upwardly therefrom a support post 148. Each support post 148 has rigidly connected to the upper end thereof a T-bar 150. A pair of guide channels 152 are rigidly secured to the undersurface of deck 122 and are constructed and arranged for engagement with T-bars 150 such that T-bars 150 are slidable longitudinally and laterally in guide channels 152 without disengagement of T-bars 150 from guide channels 152 during oscillation of blade edge 20.

It will be apparent, from the drawings and the preceding discussion, that all of the various structural modifications regarding the construction arrangement and functioning of the oscillating means and various combinations thereof, can be incorporated into an earth working machine such as that shown in FIGS. 6 through 9 as readily as such structural modifications can be incorporated with the apparatus of blade assembly 10 shown in FIGS. 1 and 2. Therefore, further discus-

sion of the possible modifications of the oscillating means and other structural elements suitable for use in the apparatus of this invention will not be presented.

The invention described above provides an oscillating blade assembly for use with earth working machines in which the blade edge is oscillatable with respect to the blade body and the rest of the blade assembly. With such apparatus the power required to operate such machinery is substantially less than the power required to oscillate an entire blade body, and the operating efficiency of earth working machinery is increased by employing the oscillatable blade assembly of this invention. An additional advantage provided by this invention arises from the use of resilient means adapted to reduce the shock delivered by the oscillating means to the supporting members of the earth working machine and adapted to augment the forward thrust delivered to the working portion of the oscillatable blade edge while working against the inertia of the material being worked. Other advantages of this invention arise from the simple and rugged construction of the oscillatable blade assembly described herein and from the ability to control and adjust the magnitude and direction of the oscillations of the blade edge by simple and rapid adjustments made in the oscillating means and the blade assembly.

FIGS. 11–18 disclose another embodiment of an oscillating blade assembly for a scraper bucket. The scraper bucket is generally designated by the numeral **200** and is illustrated in FIG. **11** as being pivotally engaged to a tractor **202**. The scraper bucket **200** includes a deck plate **204** and a rear wall **214** secured to a pair of spaced sideplates **206**. The scraper bucket **200** is pivotally movable relative to the frame by means of servomechanism **208**. The servomechanism controls the penetration depth of the blade **210** as the scraper bucket **200** is propelled by the tractor **202**. The frame of the scraper bucket **200** is supported at a fixed elevation by propelling wheels **212**. In the past, the deck plate **204** and blade **210** have been rigidly secured to the bucket sideplates **206** to form a unitary bucket structure.

As illustrated in this embodiment, a blade and deck assembly generally designated by the numeral **216** includes the forwardly extending blade **210** and the deck plate **204**. The deck blade assembly **216** is movably secured to the bucket side walls **206** and has a pair of percussion or oscillating devices **218** and **220** secured thereto. The oscillating devices **218** and **220** are rigidly secured to the blade-deck assembly **216** and impart longitudinal reciprocatory movement or oscillation to the assembly **216** to oscillate the blade **210** and assist in the dislodging action of the blade **210** as the bucket **200** is propelled by the tractor **202**.

The manner in which the blade and deck assembly **216** is movably mounted on the bucket sideplates **206**, is illustrated in FIGS. **12–16**. The bucket sideplates **206** have a pair of aligned rectangular openings **222** therein. Rearwardly of the openings **222** angular supporting guide members **224** are secured to the inner surface of each of the sideplates **206** and extend inwardly toward each other. Other angular supporting guides **226** are also secured to the inner surface of the sideplates **206** above the supporting guides **224**.

The blade and deck assembly **216** includes the blade **210** and the horizontal deck plate **204** that has a rectangular configuration with a downwardly bent front end portion to which the blade **210** is fixedly secured. A lower horizontal base plate **228** also of rectangular configuration is secured at its front edge to the downwardly bent front end of the deck from the front edge of the deck plate **204** in parallel spaced relation thereto to provide a chamber **230** therebetween. A pair of transverse channels **232** and **234** are positioned in spaced parallel relation to each other and extend transversely between the deck plate **204** and base plate **228**. The channels **232** and **234** are secured to the plates **204** and **228** in spaced relation to each other and form a transverse passageway **252** therebetween. As illustrated in FIG. **16**, transverse gusset plates **236** are secured to the deck plate **204** and base plate **228** to provide added rigidity thereto.

The blade and deck assembly includes a pair of inverted angles **240** and **242** that are secured to the base plate **228** and to the gussets **236**. The underside **244** of angles **240** and **242** have rectangular guide members **246** secured thereto and depending therefrom. The inwardly extending guide angles **224** secured to the lower portion of the bucket sideplates **206** have longitudinally extending guides **248** and **250** arranged in parallel spaced relation to each other and have the depending member **246** positioned therebetween to provide a guide rail for the members **246** and the deck blade assembly. The inwardly extending angles **226** secured to the bucket sideplates **206** have depending members **251** that limit vertical movement of the blade and deck assembly **216**. With the above arrangement the deck and blade assembly **216** is slidably supported by the bucket sideplates **206**.

Referring to FIGS. **13–16**, the manner in which the blade and deck assembly **216** is secured to the sideplates is illustrated. The deck and blade assembly **216** has the pair of spaced channels **232** and **234** extending transversely across the blade and deck assembly in spaced parallel relation to each other form the transverse passageway **252** therein. Secured to the web portion of the transverse channels **232** and **234** are a plurality of spaced resilient rubber members **254** and **256** respectively. The rubber members **254** and **256** extend inwardly toward each other and are suitably secured by means of bolts or the like. Although resilient rubber members **254** and **256** are illustrated, it should be understood that other suitable resilient means such as springs or the like, could be used in lieu thereof. Preferably, a plurality of the resilient members **254** are secured longitudinally along the transverse member **232** in spaced relation to each other and similarly a plurality of the resilient members **256** are secured to the transverse member **234** in spaced relation to each other.

A generally rectangular beam member **258** extends into the transverse passageway **252** and has end cap members **260** that secure the rectangular beam member **258** to the bucket sideplates **206** by bolts **262** or the like. As illustrated in FIG. **16**, the cap members **260** have inwardly extending portions **264** that have a rectangular recess **266** therein. The end portion of the rectangular beam member **258** is arranged to extend into the angular recess **266** to thereby rigidly secure the transverse beam **258** to the bucket sideplates **206** when the end caps **260** are secured to the sideplates by bolts **262**. As clearly illustrated in FIG. **15**, the vertical side portions of the beam member **258** abuts the front edges of the resilient members **254** and **256**. With the above arrangement the deck and blade assembly **216** is secured to the bucket sideplates **206** and is free to move longitudinally relative to the bucket sideplates a limited degree on the supporting angle guide members **224**. The resilient members **254** and **256** restrict the amount of longitudinal movement of the blade and deck assembly **216** relative to the bucket sideplates **206**.

As clearly illustrated in FIGS. **12** and **13** a pair of oscillating devices **218** and **220** are fixedly secured to the base plate **228** behind the channel member **234**. Vertical guide blocks **268** are positioned on opposite sides of the oscillating units **218** and **220** and the housings of the oscillating devices are secured to the bottom plate **228** adjacent their rear end by means of a weld **270** or the like. With this arrangement the blade and deck assembly includes a pair of oscillating devices **218** and **220** sandwiched between the deck plate **204** and base plate **228** in the chamber **230** formed therebetween. Thus, the blade and deck assembly **216** including the oscillating devices **218** and **220** is separate from the bucket **200** and is slidably supported on the bucket sideplates **206** by means of longitudinal angle guide members **224** and **226**. The transverse beam **258** extending through the passageway **252** in the blade and deck assembly **216** is secured to the bucket side plates **206** by means of the end caps **260** to thereby limit the longitudinal movement of the blade and deck assembly **216** relative to the bucket sideplates **206** so that the blade and deck assembly **216** forms a movable base or bottom on the scraper bucket **200**.

The oscillator device **218** is illustrated in detail in FIGS. **17** and **18**. It should be understood that the oscillating device **220** is substantially the same as the oscillating device **218**, as is illustrated in dotted lines in FIG. **13**.

The oscillating device **218** has a housing **272** that encloses a drive gear **274** and meshing gears **276**, **278**, **280** and **282**. All of the gears **274**, **276**, **278**, **280** and **282** are suitably supported on vertically extending shafts that are supported in bearings within the housing **272** to permit rotation of the gears. A drive gear or sprocket **284** is secured to shaft **285** on which gear **274** is nonrotatably mounted. The sprocket **284** is arranged by means of chain **286** to rotate the common shaft **285** and thereby drive gear **274**. Gear **274** is in meshing relation with gear **276** and gear **276** is, in turn, in meshing relation with gears **278** and **282**. Gear **278**, in turn, meshes with gear **280** as does gear **282**. With this arrangement, rotation of gear **274** in the direction indicated in FIG. **17** transmits rotation to the gears **276**, **278**, **280** and **282** in the direction illustrated in FIG. **17**. Secured to the upper surface of the gears **276**, **278**, **280** and **282** are eccentric weights **288**. The eccentric weights are secured to the gears **276**, **278**, **280** and **282** in the manner illustrated in FIG. **17** and are arranged to rotate with the gears **276**, **278**, **280** and **282**. With this arrangement, rotation of gear **274** through the drive chain **286** provides longitudinal reciprocatory forces to the blade and deck assembly **216** through the eccentric weights **288**. As previously stated, the housing **272** is rigidly secured to the lower deck plate **228** so that the reciprocatory forces exerted by the oscillator **218** are transmitted directly to the blade and deck assembly **216**.

The eccentric weights **288** are arranged upon rotation of gears **276**, **278**, **280** and **282** to provide the longitudinal reciprocatory forces in the following manner. As illustrated in FIG. **17**, the eccentric weights **288** are exerted a force in the direction toward the gear **274**. Rotation of the weights through a 90° angle cancels any lateral forces exerted by the eccentric weights because pairs of the eccentric weights are exerting forces in the opposite directions. Rotation through another 90° angle rotates all of the weights to a location 180° from that illustrated in FIG. **17** to provide a percussive force in a direction away from the gear **274**. With this arrangement the eccentric weights **288** are operable to provide reciprocatory percussive forces in a direction substantially parallel to the longitudinal axis of the scraper bucket **200**.

The oscillators **218** and **220** are connected to each other by means of the chain **286** and are driven by a common drive means **290** so that the gears **276**, **278**, **280** and **282** in both oscillators **218** and **220** rotate in synchronous relation to each other. Thus, there is provided a plurality of oscillators to impart percussive forces to the deck and blade assembly **216**. It should be understood that the magnitude of the forces can be regulated by means of the size of the eccentric weights **288** and the amplitude of the percussive forces can be regulated by the rotational speed of gears within the oscillator devices.

The oscillatable blade and deck assembly may be assembled and operated in the following manner. The blade and deck assembly is first positioned between the supporting and guide angles **224** and **226** extending inwardly from the bucket sideplates **206**. The rectangular beam member **258** is inserted through the openings **222** in the bucket sideplates **206** and positioned in the passageway **252** in the blade and deck assembly. The end caps **260** having the rectangular recessed portions **266** are positioned over the ends of the rectangular beam member **258** and the end caps **260** are secured to the bucket sideplates by bolts **262**. The vertical side portions of rectangular beam **258** abut the resilient members **254** and **256**. The blade and deck assembly **216** is thus positioned on the scraper bucket **200**.

The scraper bucket **200** can be utilized as a conventional scraper with the above arrangement without the use of percussive forces. Where longitudinal percussive forces are desired to assist in dislodging the earth the motor **290** or any other source of motive power suitably connected to the chain **286** and is energized to rotate the chain **286** and thereby drive the gear **274** in both of the oscillators **218** and **220**. Actuation of the oscillators **218** and **220** apply longitudinal percussive forces to the blade and deck assembly **216** to permit the blade and deck assembly **216** to oscillate relative to the bucket sideplates **206** and thus impart percussive forces to the blade **210** to more easily dislodge the earth as the scraper bucket **200** is being propelled by the tractor **202**.

When the percussive forces are in a longitudinal forward direction, the forward movement of the blade and deck assembly **216** compresses the resilient members **256**. Similarly, when the percussive force is in a direction away from the blade **210**, the resilient members **254** are compressed between the rigid rectangular beam **258** connected to the bucket side plates **206** and the transverse channel **232** secured to the blade and deck assembly **216**.

With the above arrangement it is now possible to obtain linear reciprocal percussive forces on the blade of a scraper bucket that is also assisted by the resilient means **254** and **256**.

According the provisions of the patent statutes, I have explained the principle, preferred construction and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment.

I claim:

1. In an earth working machine the combination comprising,

a bucket member having a pair of spaced sidewalls,

a blade and deck assembly including an upper deck member having a downwardly bent front end portion, a blade member secured to said downwardly bent front end portion, a parallel spaced lower base member secured to said upper deck member downwardly bent front end portion, a pair of spaced transverse members secured to said upper deck member and said lower base member and forming a transverse passageway therebetween,

a transverse beam member extending through said passageway in said blade and deck assembly, said transverse beam member secured to said bucket member sidewalls thereby connecting said blade and deck assembly to said bucket member, said transverse beam member and said pair of spaced transverse members in said blade and deck assembly arranged to slidably support a said blade and deck assembly on said bucket member for limited longitudinal movement of said blade and deck assembly relative to said bucket member,

a plurality of oscillators constructed and arranged to develop a linearly directed thrust alternately in opposite directions, said oscillators connected to said blade and deck assembly and operable to impart a linear thrust thereto in opposite directions,

drive means connected to said plurality of oscillators for simultaneous actuation of each of said oscillators, and

resilient means mounted between said oscillators and said transverse beam, said resilient means operable to supplement the percussive force exerted by said oscillators in one direction.

2. An earth working machine as set forth in claim **1**, in which,

said oscillators include rotatable eccentric weight oscillator devices secured to the upper surface of said lower base member.

3. An earth working machine as set forth in claim **1**, in which,

said transverse beam member is spaced from said pair of spaced transverse members of said blade and deck assembly, and

said resilient means including first resilient members positioned between one of said transverse members and said transverse beam member.

4. An earth working machine as set forth in claim **3** in which,

other resilient means including second resilient members positioned between the other of said transverse members and said transverse beam member.

5. An earth working machine as set forth in claim 1, in which,

said drive means includes a separate drive motor for each of said oscillators, and

mechanical means connecting said drive motors so that both of said oscillators are simultaneously driven in timed relation to each other.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,628,265 **Dated** December 21, 1971

Inventor(s) Alex J. Galis

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, Line 32	"comprises a bland body" should read - - --comprises a blade body--
Column 2, Line 17	"Figure 7 is a bottom plane view" should read- --Figure 7 is a bottom plan view--
Column 6, Line 21	"in compression spring 106" should read - - --in compressing spring 106--
Column 7, Line 70	The period was omitted after "generally by reference numeral 120"
Column 8, Line 7	After "oscillatably" insert: --to deck 122 of scraper 120 is identical to the connecting means employed in blade assembly 10 of Figure 1 to secure blade edge 20 oscillatably--
Column 8, Line 12	"shaft or bolt 36" should read - - --shaft of bolt 36--
Column 11, Line 34	"are exerted a force" should read - - --are exerting a force--

Signed and sealed this 23rd day of January 1973.

(AL)
Test:

WARD M.FLETCHER,JR.
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Commissioner of Patents