Jan. 10, 1956 H. L. OSWALT 2,730,028

TURF PERFORATOR

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Fig. 1.

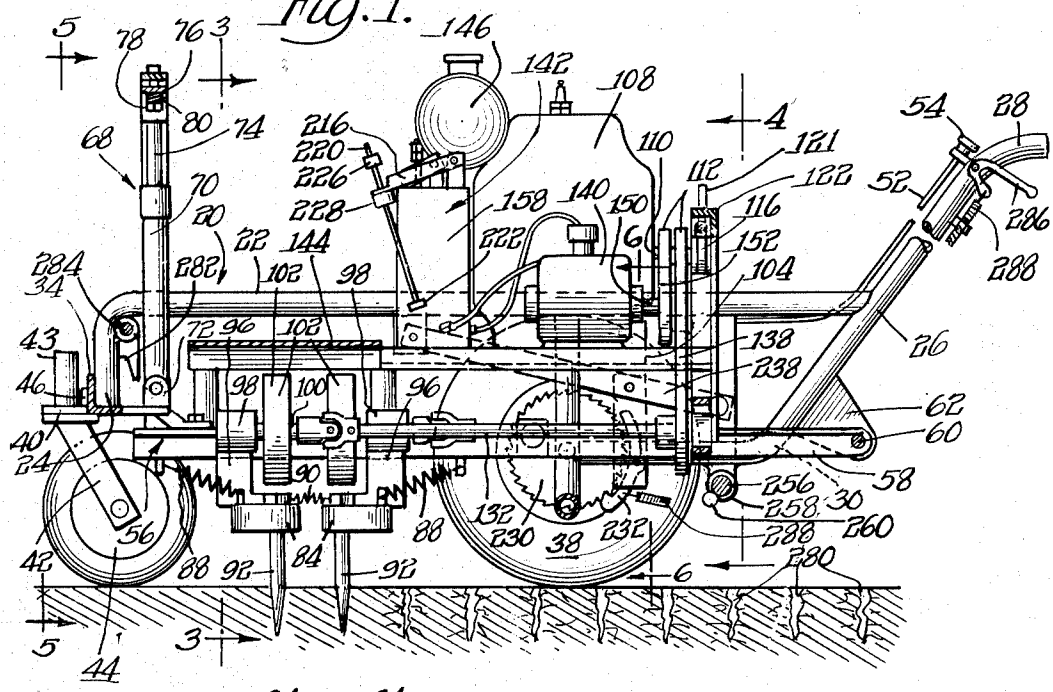
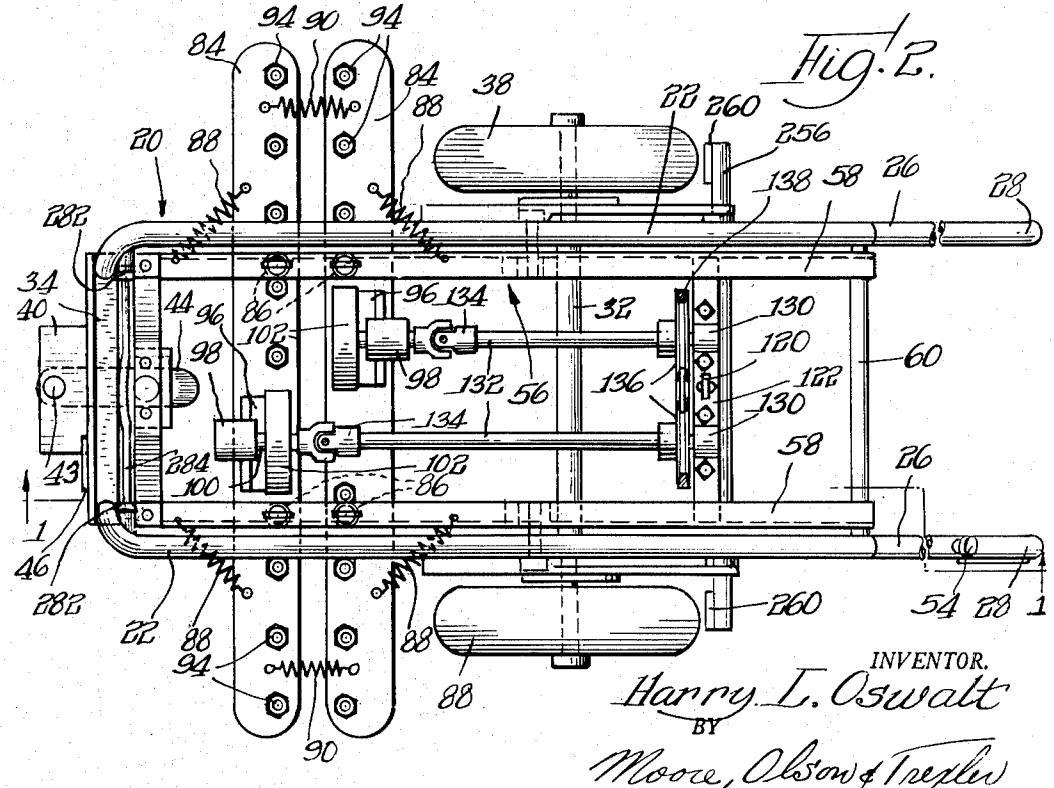


Fig. 2.



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Fig. 3.

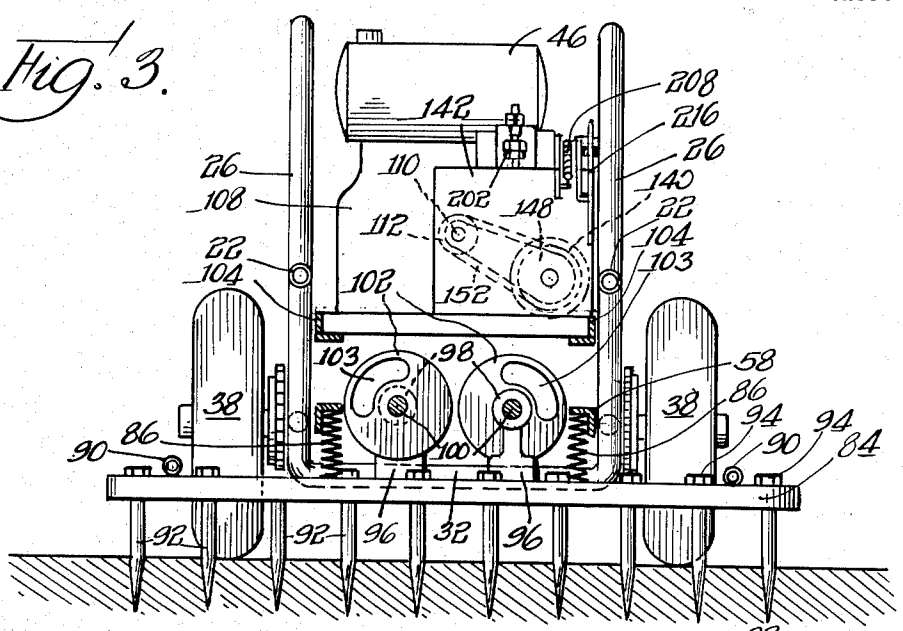


Fig. 4.

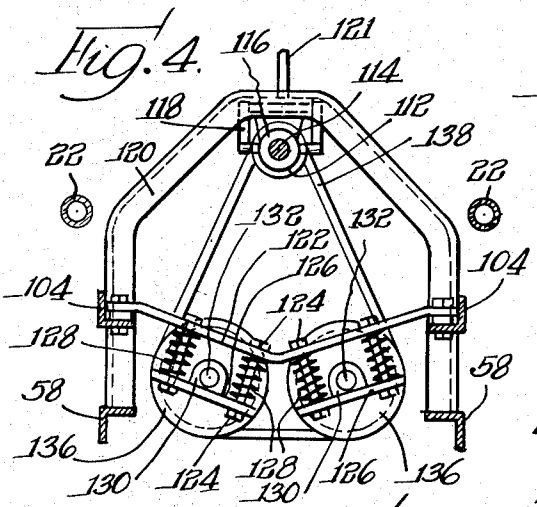


Fig. 5.

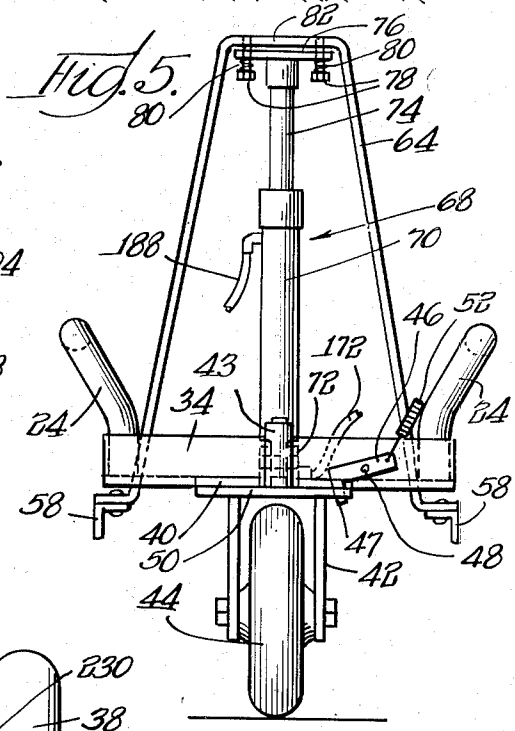
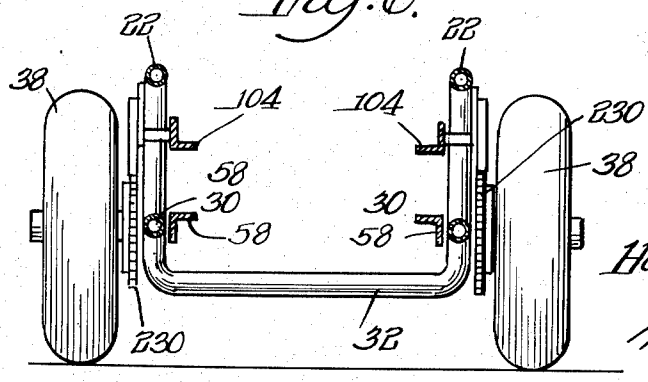


Fig. 6.



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TURF PERFORATOR

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Fig. 7.

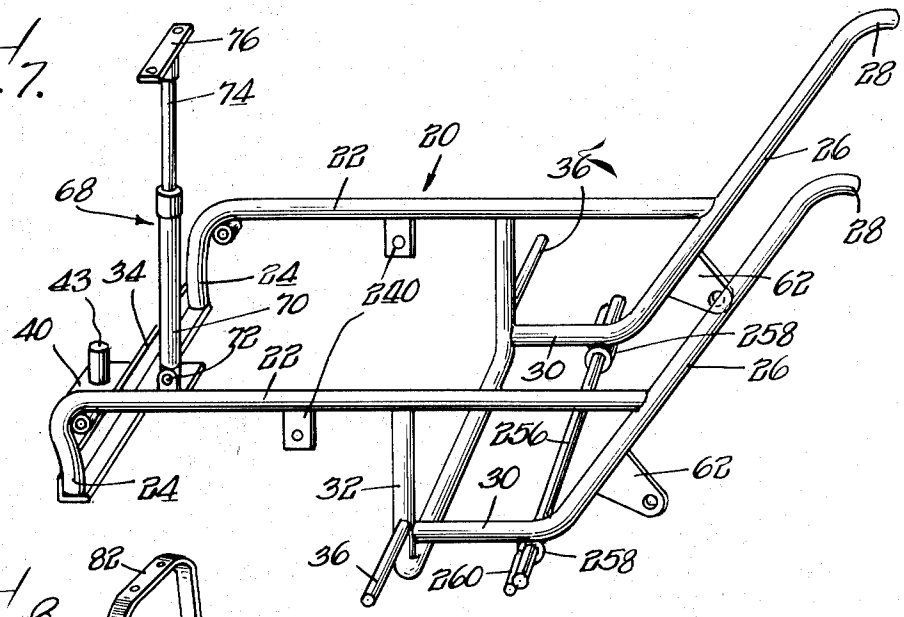


Fig. 8.

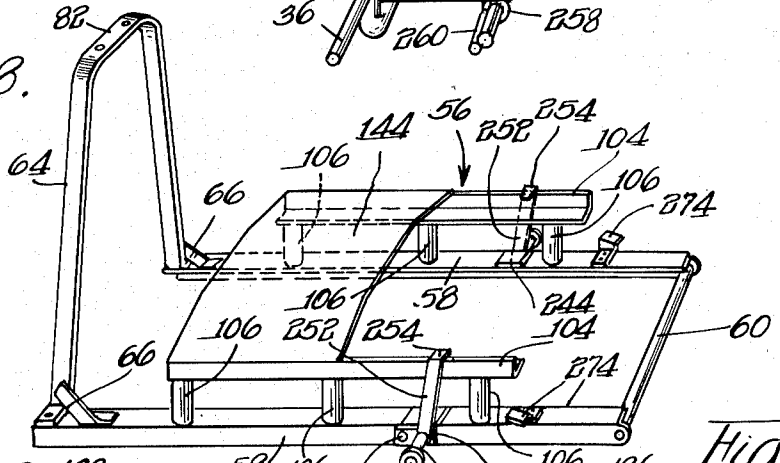


Fig. 9.

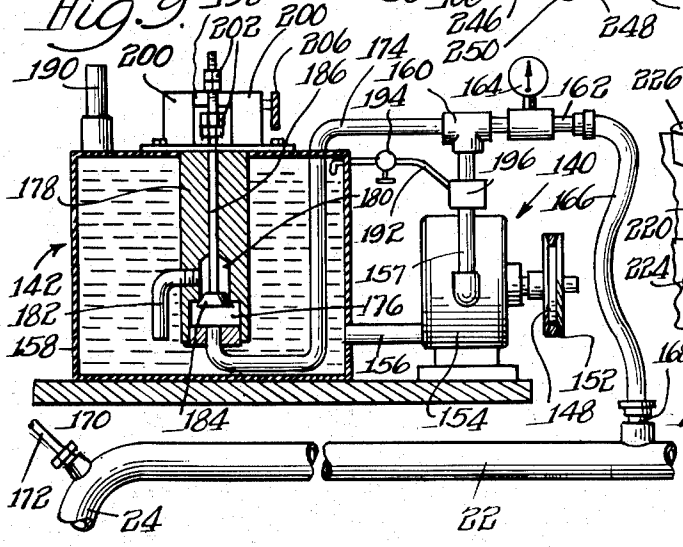
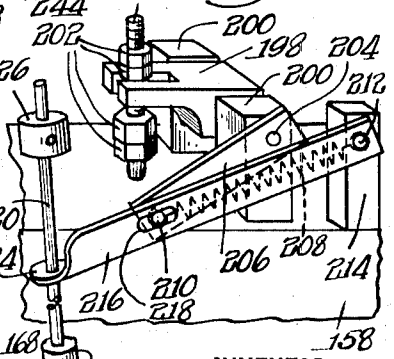


Fig. 10.



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TURF PERFORATOR

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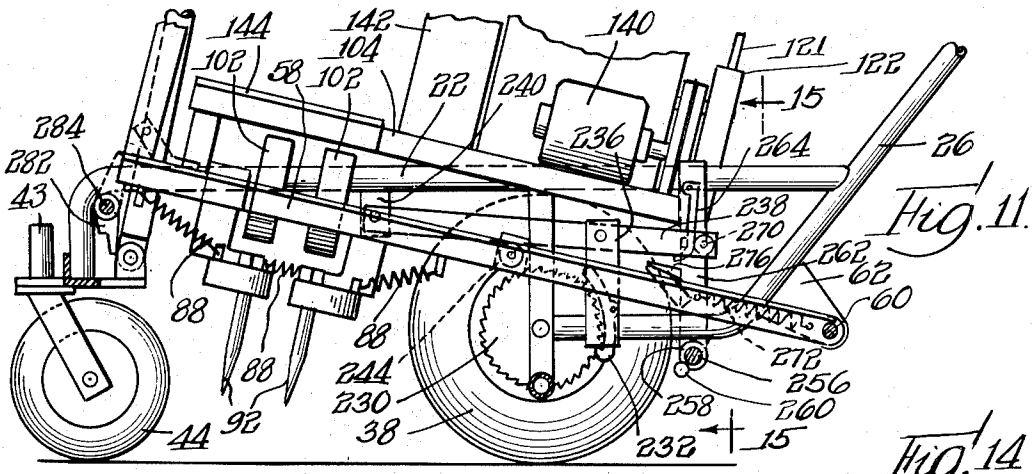


Fig. 11.

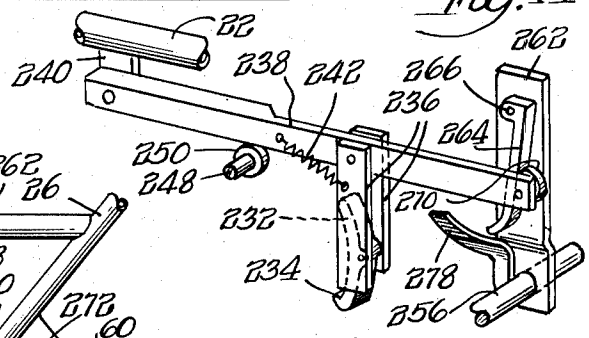


Fig. 14.

Fig. 12.

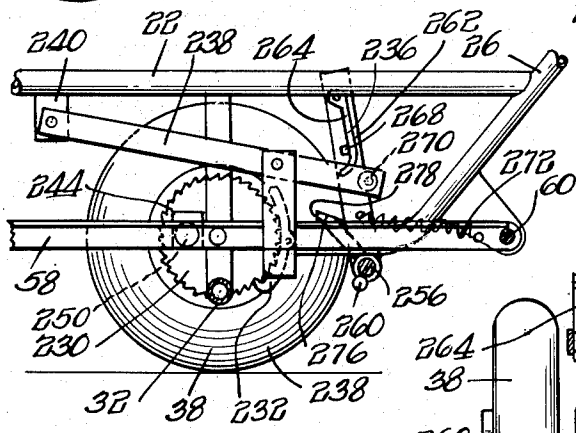


Fig. 15.

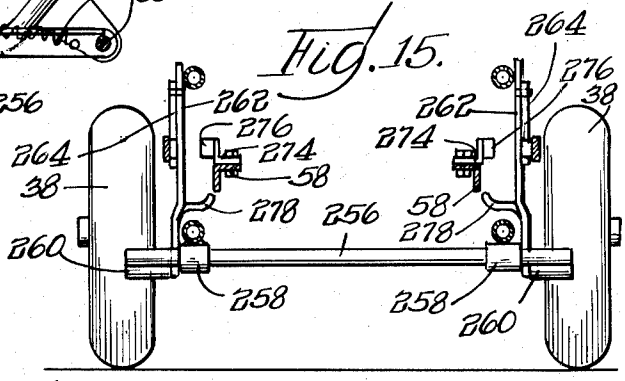


Fig. 13.

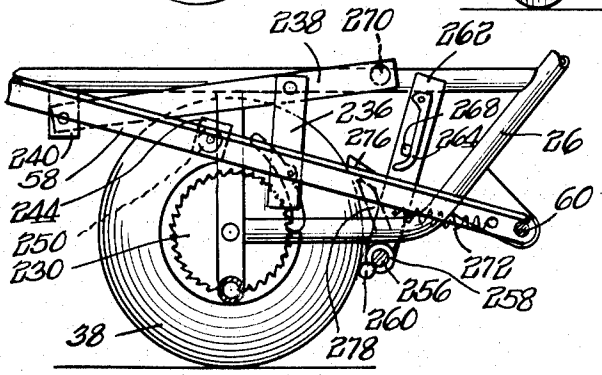
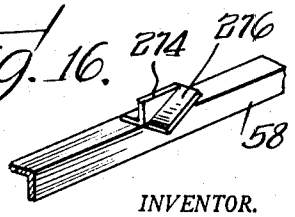


Fig. 16.



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TURF PERFORATOR

Harry L. Oswalt, Garden City, Kans.

Application February 20, 1951, Serial No. 211,933

17 Claims. (Cl. 97—34)

This invention is concerned generally with a machine or mechanism for perforating turf for aeration, watering, fertilizing, seeding, sanding or the like, and particularly to such a machine or mechanism for vigorously vibrating the turf in addition to perforating the turf.

In many areas of the world, particularly the Central Plains States of the United States, finely divided top soil blows on to turf and sod and forms a crust thereon which is extremely difficult for air, water and fertilizer to penetrate. When this layer becomes wet slightly, then bakes in the sun, it becomes practically impervious.

An object of this invention is to provide a new or improved machine or mechanism for perforating turf for aeration, watering or the like.

A further object of this invention is to provide an apparatus for perforating turf and vigorously vibrating the turf to loosen it.

A more specific object of this invention is the provition of an apparatus for perforating turf and vigorously vibrating it with an oscillating motion.

A further object of this invention is to provide an apparatus for perforating turf without tearing up the ground or leaving a rough surface.

Another object of this invention is to provide an apparatus for perforating turf which apparatus is substantially automatic in action.

This invention contemplates achieving the foregoing objects by the provision of a self-powered vehicle carrying one or more platforms shiftable toward and away from the earth. Each such platform carries a plurality of spikes adapted to be driven into the earth upon lowering of the platforms. Each of the platforms is spring mounted and carries an eccentric fly wheel adapted vigorously to vibrate the platform and spikes and thus vigorously to vibrate the earth to loosen it. The spikes are lowered and lifted substantially vertically to preclude tearing up the earth and the apparatus or vehicle is moved along the earth only during such times as the spikes are raised from contact with the earth.

Other and further objects and advantages of the present invention as well as a specific embodiment thereof will be understood from the following description when taken in connection with the accompanying drawings wherein:

Fig. 1 is a longitudinal sectional view taken along the line 1—1 of Fig. 2 of a turf perforator;

Fig. 2 is a top view thereof, the upper portions being removed;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 1;

Fig. 5 is a view taken along the line 5—5 of Fig. 1;

Fig. 6 is a view taken along the line 6—6 of Fig. 1;

Fig. 7 is a perspective view of the main frame of the apparatus;

Fig. 8 is a perspective view of the hinged or shiftable frame;

Fig. 9 is a somewhat schematic view of the hydraulic actuating unit;

Fig. 10 is a perspective view of the hydraulic valve control;

Fig. 11 is a partial side view showing the hinged or shiftable platform in raised position and illustrating the driving of the apparatus;

Fig. 12 is a fragmentary side view further illustrating the driving of the apparatus;

Fig. 13 is a fragmentary side view similar to Fig. 12 with the parts in another position and further illustrates the driving;

Fig. 14 is a fragmentary perspective view of a portion of the driving and braking mechanism;

Fig. 15 is a partial rear view showing a portion of the braking mechanism; and

Fig. 16 is a fragmentary perspective view of a portion of the brake mechanism.

Referring now in greater particularity to the drawings, a turf perforator embodying the principles of my invention may be seen to comprise a main frame 20 (Figs. 1, 2 and 7). The main frame is comprised mainly of tubular stock or pipe and includes a pair of longitudinal members 22 downturned at their forward ends as at 24. Diagonally disposed handle members 26 having curved or curled over grips 28 are secured at the rear ends of the longitudinal members 22 and have lower diagonally and horizontally extending portions 30 carried forward to junctions with a U-shaped spacer frame member 32. The forward depending ends 24 of the longitudinal frame members 22 are maintained in spaced apart relation by an angle iron 34 connected therebetween. All of the parts enumerated heretofore preferably are welded together.

A pair of horizontally extending stub axles 36 are welded or otherwise suitably secured to the vertical leg portions of the U-shaped spacer member 32 and a pair of rubber tired drive wheels 38 are suitably mounted thereon. I have not shown the wheel mounting in detail as suitable wheel mountings are well known in the art and any desirable type may be used, alough I prefer to utilize roller bearings to keep friction at a minimum.

A plate or platform 40 is welded or otherwise suitably secured to the under side of the angle member 34 or may be welded in a recess therein (see also Fig. 5). A fork 42 is rotatably mounted in a hub 43 upstanding from the plate 40 and a rubber tired wheel 44 is rotatably mounted on a shaft between the tines of the fork 42. A control lever 46 having a nose or detent 47 is pivoted at 48 on the upstanding flange of the angle member 34. The weight of the detent and friction between the parts normally causes the detent 47 to extend through an aperture in the plate 40 and into an aperture in a plate 50 carried at the top of the fork 42 to maintain the wheel 44 in parallelism with the drive wheels 38. A flexible control member such as a Bowden cable 52 interconnects the control lever 46 and an operating member 54 carried on one of the handles 26 near the grip 28 thereof to allow retraction of the detent to turn the turf perforator from a straight path.

A pivoted or hinged frame 56 (Figs. 1, 2 and 8) comprises a pair of longitudinal angle members 58 spaced

at their rear ends by a bar **60** and pivoted thereat to a pair of ears **62** extending downwardly and rearwardly from the handles **26**. The angle members **58** at their forward ends are connected to, and spaced by an inverted substantially U-shaped strap or hanger **64** by bolts, welding or other means and braced by rigid straps or bars **66** angularly disposed between the longitudinal members **58** and the legs of the U-shaped strap or hanger **64**.

The hanger **64**, and consequently the forward end of the pivoted frame **56**, is supported by a jack **68** (see also Fig. 5) the jack including a hydraulic cylinder **70** pivotably mounted at its lower end by a bracket **72** on the rear of the plate **40**. A piston **74** fits within the cylinder **70** and extends upwardly therefrom, carrying a transversely arranged mounting plate **76** at its upper end. A pair of bolts **78** fit through coil springs **80** and through apertures in the mounting plate **76**, and are threaded into apertures in the bight **82** of the substantially U-shaped strap or hanger **64**. Hydraulic mechanism, as will be described later, is provided for raising and lowering the jack to shift the pivoted or shiftable frame **56** from lowered horizontal position as shown in Fig. 1 to elevated position as shown in Fig. 11.

A pair of platforms **84** is mounted on the shiftable platform **56** by means of compression springs **86**. Each of the platforms is provided with a pair of compression springs **86** and the springs extend downwardly from the longitudinal angle members **58** to the tops of the platforms. The springs may be secured to the frame members and to the platforms in any desirable manner and I have found that it sometimes is desirable to pass guide rods or bolts through the springs along the axes thereof to aid in maintaining proper orientation of the platforms relative to the shiftable frame **56**. The platforms further are oriented by positioning tension springs **88** stretched between the platforms **84** and the longitudinal frame members **58** and by tension springs **90** stretched between the platforms **84**. The springs **88** and **90** may be secured to apertured pins or by any other suitable or desirable means.

Each of the platforms **84** comprises a flat plate provided with a depending peripheral skirt for rigidity. A plurality of spikes **92** is secured to each platform by means of nuts **94**, each spike having a threaded neck of decreased diameter extending upwardly through the platforms **84** to receive the nuts **94**. The spikes **92** may be of any desired, sharpened configuration, but I have found that cylindrical spikes having substantially conical lower ends are most effective and are simple and inexpensive to manufacture.

Each of the platforms **84** further is provided with an upstanding angle bracket **96** having a bearing boss **98** at the upper end. A stub shaft **100** is journaled in each of the bearing bosses **98** and carries a fly wheel **102**. Each of the fly wheels is eccentrically weighted and I, therefore, shall refer to them as eccentric fly wheels hereafter. The fly wheels preferably are constructed with peripheries concentric with the stub shafts **100** and have apertures **103** to provide an eccentric weight distribution. It will be understood, of course, that other types of eccentrically weighted fly wheels including symmetrical fly wheels mounted off center could be used.

A raised motor mount is provided on the hinged, pivoted or shiftable frame **56** by means of a pair of longitudinal angle members **104** supported by a plurality of spacers **106** extending upwardly from the longitudinal frame members **58**. An internal combustion engine or motor **108** of any desired type and having a crank or drive shaft **110** extending therefrom is secured on the angle members **104** toward the rear thereof by any suitable means. A double pulley **112** (Figs. 1–4) is mounted on a stub shaft **114** journaled in a bearing **116**. The bearing **116** is carried by a shiftably mounted bracket **118** on an inverted, substantially U-shaped support **120** welded to the longitudinal frame members **58** and to the motor supports **104**. A handle **121** is provided for shifting the bracket **118** and bearing **116** back and forth for bringing the stub shaft **114** into driving engagement with the motor shaft **110**, suitable clutch mechanism being provided for this purpose.

A substantially V-shaped supporting bar **122** (Figs. 2 and 4) extends between the motor supports **104** to which it is bolted near the rear ends thereof. Each arm of the V-shaped support has a pair of bolts **124** passed through it and also through a plate **126**. Nuts are threaded on to the ends of the bolts and coil springs **128** are compressed between the arms of the support and the plates **126**. A bearing **130** is suitably mounted on each of these plates and a jack shaft **132** is journaled in each of the bearings and extends forwardly to one of the stub shafts **100**, each of the jack shafts **132** and stub shafts **100** being connected by a universal joint **134**. Pulleys **136** are fixed to the jack shafts **132** near the bearings **130**, and a drive belt **138** is passed over the pulley **112** and the pulleys **136** to drive the jack shafts **132** and eccentric fly wheels **102**.

The longitudinal motor supports **104** additionally support a hydraulic unit **140** (Figs. 1 and 3), a hydraulic fluid or oil reservoir **142** and a shield **144** (see also Fig. 8) carried above the fly wheels **102** to preclude an operator's being contacted thereby. A gasoline tank **146** is supported by the motor casing above the oil reservoir **142**. The hydraulic unit **140** is provided with a pulley wheel **148** on an outwardly extending shaft **150**, and this pulley wheel is driven by a belt **152** passed over the double pulley **112**.

The hydraulic unit **140** and oil reservoir **142** are shown schematically in Fig. 9. The hydraulic unit **140** comprises a pump **154** having an inlet line or conduit **156** connected directly to the tank **158** of the oil reservoir **142**. The pump **154** is provided with a discharge line or conduit **157** leading to a T pipe connection **160**. One side of the T pipe connection leads through a conduit **162** including a testing pressure gauge **164** to a flexible hose or conduit **166**. The hose **166** is coupled in turn to a hydraulic fitting **168** on one of the tubular longitudinal frame members **22** of the main frame **20**. A hydraulic connection **170** at the front of the member **22** at the elbow formed with the depending section **24** is connected to a hose **172** leading to the lower end of the hydraulic cylinder **70** (see also Fig. 5). It will be understood that the longitudinal frame member **22** can be plugged above the hydraulic connection **168** and below the connection **170**, but that this not necessary as the tubular frame member **22** is closed at both ends by the members to which it is welded and plugging the frame member would serve only to reduce the total quantity of oil needed in the system.

The other side of the T connector **160** is connected to a line or conduit **174** leading to a chamber **176** in the lower end of a valve structure **178** within the tank **158** and depending from the top thereof. The valve structure **178** is provided with a passageway **180** having a drain line **182** leading from near the upper end thereof into the tank **158**. A frusto conical valve member **184** is carried on the lower end of a valve stem **186** and in its uppermost position closes the passageway **180** off from the chamber **176**.

It will be apparent that with the valve member **184** in the position shown in Fig. 9, hydraulic fluid or oil pumped through the inlet line **156** and through the outlet line **157** cannot pass through the conduit **174** and thus must establish a pressure in the line **162**, hose **166**, frame member **22**, and hose **172** to raise the jack **68** and thereby to raise the pivoted or shiftable frame. When the valve stem **186** is lowered by means shortly to be described to its lowermost position, the valve member **184** is lowered to establish a fluid connection from the pump **154** through the discharge line **157**, conduit **174**, chamber **176**, passageway **180**, and drain line **182** into the tank **158**. Thus no pressure can be built up in the hydraulic circuit previously set forth to raise the jack and the weight of the shiftable or pivoted frame will cause the jack to lower,

expelling fluid reversely through the circuit set forth for raising the jack and into the tank **158** through the conduit **174**.

A drain back hose **188** (Fig. 5) is connected to the upper end of hydraulic cylinder **70** of the jack **68** and leads into the upper end of the tank **158** at any convenient location (not shown) to discharge oil leaking past packing at the lower end of the piston **74**. The tank **158** is provided with an oil filler and breather **190**. A relief line **192**, having a hand operated relief valve **194**, leads from a hydraulic connector **196** on the discharge conduit **157** into the upper end of the tank **158** to allow lowering of the jack by hand without lowering the valve stem **186** and valve member **184**.

Means for shifting the valve stem **186** up and down is shown in Figs. 1 and 10. This means includes a bifurcated lever **198** pivoted between upstanding bracket arms **200** on top of the tank **158**. The upper end of the valve stem **186** is received between the pivoted arms of the lever **198**, and nuts **202** are threaded on to the stem above and below the lever adjustably to link the stem to the lever. The lever arm **198** is pinned or keyed to the shaft or axle **204** on which it is mounted and a second lever arm **206** consisting of a strip of sheet metal likewise is fixed to this shaft so that the two levers must pivot in unison. A coil spring **208** is stretched between a pin **210** at the end of the lever **206** and a pin **212** on an upstanding arm **214** on top of the tank **158**.

An actuating arm **216** is pivoted on the pin **212** and is provided with a slot **218** to receive the pin **210** on the lever arm **206**. It will be seen that shifting the control arm **216** up or down will pivot the lever **206** to raise or lower the valve stem **186** and that the spring **208** causes the lever **206** to snap past a dead center position positively to preclude any possibility of the valve member **184** coming to rest in a position other than completely closed or completely open.

A control rod **220** is pivoted at its lower end at **222** on the left longitudinal frame member **22** of the fixed frame **20** and fits through an aperture in a transversely directed ear **224** on the control arm **216**. Stops **226** and **228** are adjustably fixed to the control rod **220** above and below the control arm ear **224** to contact the ear and pivot the arm as the shiftable or pivoted frame is lowered or raised.

Means for driving my turf perforator may be seen in Figs. 1, 6 and 11–16. Identical means are provided on each side of the perforator and therefore only one side will be described. A ratchet wheel **230** is fixed to each of the two driving wheels **38** and spaced inwardly a short distance therefrom. Each ratchet wheel is adapted to be driven by a pawl **232** having a tooth **234** engaging the teeth of the ratchet wheel **230**. The pawl **232** is pivoted intermediate its ends between a pair of plates **236** which are pivoted in turn, at their upper ends, on an actuating bar or strut **238**. The strut **238** is pivoted at its forward end on an ear **240** depending from each longitudinal frame member **22** of the fixed or main frame **20**. A coil spring **242** is stretched between one of the plates **236** and the strut **238** forwardly thereof to urge the plates **236** toward the ratchet wheel **230**. Suitable spring means (not shown) may be utilized to urge the pawl tooth **234** into driving engagement with the ratchet wheel **230**.

Each of the longitudinal angle frame members **58** of the shiftable or pivoted frame **56** is provided with a bracket **244** (see also Fig. 8) shiftable longitudinally thereon and locked in adjusted position by means such as a set screw **246** bearing against the frame member **58**. A stub axle **248** extends outwardly from the bracket **244** and carries an actuating roller **250**. Each of the stub axles **248** is braced by a diagonal strut **252** having an upper bent-over tab **254** engaging the upwardly directed flange of the longitudinal motor support **104**.

Positively to preclude movement of my turf perforator along the ground while the spikes are entering the ground, and thus to preclude digging up small sections of turf and leaving a rough finish, I have provided brake mechanism to movement of the turf perforator prior to engagement of the spikes with the ground. Such brake mechanism is similar on both sides of the perforator and only one side therefore will be described. Referring specifically to Figs. 1 and 11–16, the brake mechanism will be seen to include a transverse rod or pipe **256** suitably pivoted in bearings **258** (see also Fig. 7 and particularly Fig. 15) secured to the under sides of the horizontal portions **30** of the handles **26**. The transverse rod **256** is provided near each end with a section of rod or pipe **260** arranged in parallel contacting relation therewith and welded thereto. The positions and dimensions of the rod **256** and rod sections **260** are such that rotation of the rod **256** will bring the sections **260** into frictional engagement with the tires of the driving wheels **38** to prevent rotation thereof.

A brake actuating arm **262** is fixed near each end of the rod **256** intermediate one of the bearings **258** and one of the rod sections **260**. Each of the actuating arms **262** is provided near its upper end with a cam track **264** pivoted at its upper end at **266** and having its movement forwardly of the turf perforator limited by a stud **268** on the arm **262**. A roller **270** is carried at the extreme rear end of each of the actuating arms or struts **238** and is adapted to engage one of the cam tracks **264** to pivot the actuating arm **262** and release the brakes. The brakes are applied by means of springs **272** stretched between the arms **262** and the longitudinal shiftable frame members **58**.

Each of the angle frame members **58** is provided with an angle bracket **274** bolted thereto and providing an inclined cam surface **276**. A curved bracket **278** is welded to the inner face of each of the brake arms **262** and is adapted to contact the corresponding inclined cam surface once during each cycle of operation of the turf perforator as will be apparent from the ensuing paragraphs.

Operation of the turf perforator is as follows: Assuming the hinged, pivoted or shiftable frame **56** to be in the raised position shown in Fig. 11, the ear of the actuating arm **216** on the hydraulic fluid or oil reservoir will be just about to encounter the stop **226** on the actuating rod **220** and shortly thereafter will be snapped past dead center position by the spring **208** to shift the valve member **184** to open position as the shiftable platform reaches its uppermost position. This allows hydraulic fluid to drain from the jack **68** and the weight of the shiftable frame and parts carried thereby will cause it to descend to the position shown in Fig. 1. It will be understood that the turf perforator is not moving forwardly at this time, the brakes having just stopped it as will be apparent shortly. The weight of the shiftable frame and parts carried thereby forces the spikes **92** into the ground and the vigorous vibration of the spikes due to the constant rotation of the eccentric fly wheels **102** on the spring mounted platforms **84** aids in penetration. As the spikes penetrate the ground, and after they have reached their full depth of penetration, the earth intermediately adjacent the spikes will be vigorously vibrated thereby. The motion imparted to the earth or turf by the spikes **92** is oscillatory and loosens the earth in a most efficacious manner to allow aeration, fertilization, watering or the like. The spikes **92** are vibrating constantly and therefore any packing of the edges of the holes by penetration of the spikes is loosened as the spikes are withdrawn to leave irregular spike holes **280**. It will be understood that the spikes **92** are positioned a sufficient distance from the pivot **60** of the shiftable frame so that the insertion and withdrawal of the spikes is nearly vertical and does not break up the surface of the turf to leave a torn and rough finish.

When the spikes have penetrated to the desired depth, the shiftable frame has dropped a sufficient distance for

the ear of the actuating arm or lever **216** to engage the lower stop **228** on the control or actuating rod **220**. The arm **216** then is pivoted by the stop **228** until the spring **208** takes over to raise the valve stem **186** and bring the valve member **184** into closed position. As pressure builds up in the system, the jack **68** is raised to lift the pivoted frame **56** and thereby to raise the spikes **92** from the ground.

As the pivoted frame **56** rises, the rollers **250** thereon engage the under side of the actuating arms or struts **238** and pivot them to raise the pawls **232** and thereby to rotate the ratchet wheels **230** to drive the turf perforator forwardly. It will be apparent that no forward motion can be imparted to the turf perforator until the spikes **92** have been lifted from the ground and the spikes therefore cannot tear the ground.

While the struts **238** are being raised by the rollers **250**, the rollers **270** move from the position shown in Fig. 12 to that shown in Fig. 11 and roll along the back of the cam track **264**. This holds the brake arms **262** forwardly against the action of springs **272** and holds the brakes in off position. In the position shown in Fig. 12, the brakes are held in off position by the inclined cam surface **276** carried by the angle frame members **58** bearing down on top of the curved brackets **278** and holding the transverse bar **256** pivoted in counterclockwise position.

As the rollers **270** pass over the tops of the cam tracks **264**, the brake actuating arms **262** are freed from restraint and are pivoted clockwise to the position shown in Fig. 13 under the influence of springs **272** to force the rod sections **260** against the tires of the wheels **38** to brake the forward movement of the turf perforator. Each pawl **232** at this time has reached its upper limit of movement and no longer exerts any driving force. The turf perforator therefore ceases its forward movement. Subsequent lowering of the pivoted frame as set forth heretofore releases the brakes and sets the pawls to advance ratchets for another forward motion.

In order to transport my turf perforator, I have provided latch members **282** pivoted on cross bar **284** at the forward end of the main frame **20** which may be shifted beneath the ends of the longitudinal angle frame members **58** of the shiftable frame **56** when the latter is in raised position to maintain the frame in raised position.

A lever **286** is pivoted to the handle **26** adjacent the control or operating member **54** and is connected by suitable flexible connections such as Bowden cables **288** to the pawls **232** to maintain them retracted from driving engagement with the ratchet wheels **230**. Bowden cable connections are well known and I therefore have omitted the details of their connections to the pawls from the drawings for simplicity of illustration. It is apparent that with the hinge frame in raised position and the pawls retracted from the ratchets the turf perforator can be rolled readily along the ground to any desired position. The turf perforator readily is steered when the control knob **54** is actuated to remove the detent **47** of the lock lever **46** from the aperture in the plate **50** above the front wheel.

It is apparent that the objects of this invention have been met. My turf perforator perforates the turf and vigorously vibrates the same to loosen the turf for aeration, fertilization, watering or the like. The turf perforating spikes remain in the ground for a plurality of vibrations to insure proper loosening of the soil. The turf perforator is substantially automatic in action and, additionally, the simple valve and conduit construction of the hydraulic actuating means precludes the necessity of a large number of valves and conduits.

Although my invention has been described throughout the specification with regard to perforation and loosening of earth for irrigation, aeration, and other purposes, it will be apparent that the machine has use in loosening materials other than turf. For instance, it has been found that the machine is extremely effective in removing ice from sidewalks, roadways, and the like. By using the machine for turf loosening in the summertime and ice loosening and removal in the wintertime, substantially year-around use is insured. This makes the use of my machine much more economical as it is not left lying idle while the initial cost is being amortized.

The specific example shown and described herein is for illustrative purposes only and various changes may be made in the details of construction thereof without departing from the spirit and scope of my invention as set forth in the following claims.

I claim:

1. Apparatus for loosening hard material comprising a frame, means including wheels for moving said frame along the surface of said material, a floating platform, impositive means only for supporting said floating platform from said frame free for restrained movement in any direction relative thereto, a plurality of sharpened, elongated spikes carried by said platform for perforating the surface of said hard material, means for lowering said spikes into the material, means for vigorously vibrating said floating platform while said spikes are in the material thereby to vigorously vibrate the material to loosen the same, and means for lifting said spikes from the material for movement of said frame along the surface thereof.

2. Apparatus for loosening hard material comprising a frame, a pair of wheels on said frame, a platform, spring means forming the sole support for said platform from said frame, said platform thereby being free for restrained movement in any direction relative to said frame, a plurality of sharpened spikes carried by said frame for perforating the surface of said hard material, means for lowering said spikes into the material, means for vigorously vibrating said platform while said spikes are in the material, vigorously to vibrate the material to loosen the same, and means for lifting said spikes from the material for movement of said frame along the surface thereof.

3. A machine for loosening hard material including a frame, means including wheels for moving said frame means along the surface of said hard material, a platform, spring means forming the sole support for said platform from said frame, said platform thereby being substantially free for restrained movement in any direction relative to said frame, a plurality of sharp spikes carried by said platform, means for lowering said spikes into said material, an eccentric flywheel on said platform, means for rotating said flywheel vigorously to vibrate said platform and thereby vigorously to vibrate the material while said spikes are in the material, and means for lifting said spikes from the material for movement of said frame therealong.

4. Apparatus for loosening material comprising a frame, means for moving said frame along the surface of said material, a plurality of sharp spikes carried by said frame for perforating the material, means for lowering said spikes into the material, means for vigorously vibrating said spikes through a plurality of vibrations while in the material vigorously to vibrate the material to loosen the same, means for lifting said spikes from the material for movement of said frame along the surface thereof, and power means for operating all of said foregoing means in timed relation in the order listed.

5. A machine for loosening material comprising supporting means, means for moving said supporting means along the surface of said material, means for braking movement of said supporting means along said surface, a plurality of sharp spikes carried by said supporting means for perforating the material, means for lowering said spikes into the material, means for raising said spikes from the material for movement of said supporting means along the surface of said material, and power means for operating all of said foregoing means in timed relation in the order listed.

6. Apparatus for loosening material comprising supporting means, means for moving said supporting means along the surface of said material, means for braking

movement of said supporting means along said surface, a plurality of spikes carried by said supporting means for perforating the material, means for lowering said spikes into the material, means for vigorously vibrating said spikes while in the material vigorously to vibrate the material to loosen the same, means for lifting said spikes from the material for movement of said supporting means along the surface thereof, and power means for operating all of said foregoing means in timed relation in the order listed.

7. A machine for loosening material comprising supporting means, means for moving said supporting means along the surface of said material, means for braking movement of said supporting means along said surface, a plurality of spikes carried by said supporting means for perforating the material, means for lowering said spikes into the material, mechanism for raising said spikes from the material, mechanism actuated by said spike raising mechanism to operate said moving means, and means operated by one of said mechanisms to operate said braking means after a predetermined distance of movement along the ground.

8. A machine for loosening material comprising supporting means, means for moving said supporting means along the surface of said material, means for braking movement of said supporting means, a plurality of spikes carried by said supporting means for perforating the material, means for vigorously vibrating the spikes while in the material whereby vigorously to vibrate the material to loosen the same, mechanism for raising said spikes from the material, mechanism actuated by said spike raising mechanism to operate said moving means, means operated by one of said mechanisms to operate said braking means after movement a predetermined distance along said surface, and means for thereafter lowering said spikes into the material.

9. A machine for loosening material comprising supporting means, means for moving said supporting means along the surface of said material, means for braking movement of said supporting means, a platform, means including spring means for supporting said platform from said supporting means substantially free for movement in any direction relative to said first named supporting means, a plurality of spikes on said platform adapted to perforate said material, means for vigorously vibrating said platform with said spikes in the material whereby vigorously to vibrate the material to loosen the same, mechanism for raising said platform to lift said spikes from the material, mechanism actuated by said platform raising mechanism to operate said moving means, means operated by one of said mechanisms to operate said braking means after a predetermined distance of movement of said supporting means along said surface, and means for thereafter lowering said platform to lower said spikes into the material.

10. A machine as set forth in claim 9 wherein the means for vibrating said platform includes means for constantly vibrating said platform with an oscillatory motion.

11. A machine as set forth in claim 9 for loosening soil wherein the means for vibrating the platform includes an eccentric flywheel mounted for rotation on said platform and means for rotating said flywheel.

12. A machine as set forth in claim 11 wherein the spikes carried by the platform are substantially perpendicular to the surface of said material and the means for raising the platform and the means for lowering the platform include means for limiting this movement substantially to the vertical to insure substantially vertical withdrawal and insertion of the spikes to prevent tearing of the surface of the material.

13. A machine as set forth in claim 12 wherein the means for raising the platform, the means for lowering the platform, and the means for limiting such movement substantially to the vertical includes an elongated frame carrying said platform at one end and pivoted to said supporting means at the other end.

14. A machine for loosening material comprising a main frame, a plurality of wheels for moving said main frame along the surface of said material, means including pawl and ratchet means for periodically rotating at least one of said wheels a predetermined distance to move said machine a predetermined distance along said surface, braking means for stopping rotation of said wheels after movement through said predetermined distance, a shiftable frame carried by said main frame and pivoted at one end thereto, a hydraulic jack supporting the other end of said shiftable frame from said main frame, a platform, means including spring means for supporting said platform from said shiftable frame substantially free for restrained movement in any direction relative to said shiftable frame, a plurality of spikes carried by said platform and adapted to perforate the material, an eccentric flywheel, means for mounting said flywheel for rotation on said platform, means for rotating said eccentric flywheel vigorously to vibrate said platform and thereby vigorously to vibrate the material when said spikes are in the material to loosen said material, hydraulic actuating means for operating said hydraulic jack to lower and raise said shiftable frame whereby to cause said spikes to perforate and leave the material, means engaged by said shiftable frame as said frame is raised to operate said pawl and ratchet means to move said main frame along the surface of said material, and means engaged by said last named means upon raising of said shiftable frame and actuation of said pawl and ratchet operating means to operate said braking means.

15. Apparatus for loosening material comprising supporting means, means for moving said supporting means along the surface of said material, a plurality of spikes carried by said supporting means for perforating the material, means including a constantly rotating eccentric flywheel the axle of which is rigidly interconnected with said spikes for vigorously vibrating said spikes and thereby vigorously to vibrate the material when said spikes are in the material, means including hydraulic means for lifting said spikes from the material for movement of said supporting means along the surface of said material and for thereafter lowering said spikes into said material, and means controlled by lifting of said spikes for moving said supporting means along the surface of said material.

16. Apparatus for loosening material comprising a frame, a plurality of wheels for transporting said frame above a surface, a carrier, substantially vertically disposed spring means for supporting said carrier from said frame substantially free for restrained movement in any direction, substantially horizontally disposed spring means between said carrier and said frame for controlling horizontal movement of said carrier, a plurality of substantially straight, sharpened spikes carried by said carrier for spiking into said surface, means for vigorously vibrating said carrier and said spikes to aid in spiking into said surface and for loosening the material of said surface, and means for pivoting said frame about said wheels to move said spikes to and from said surface substantially longitudinally of said spikes.

17. A turf perforator comprising a frame, a plurality of wheels adjacent one end of the frame for transporting the frame along the ground, a carrier suspended from adjacent the opposite end of the frame by a floating connection which provides restrained movement of said carrier in any direction and said floating connection comprising a first spring means positioned to yieldingly restrain movement of the carrier in a substantially vertical plane and a second spring means angularly positioned relative to the position of said first spring means to yieldingly restrain movement of the carrier in a substantially horizontal direction, a plurality of sharpened spikes carried by said carrier in parallel array, means for vigorously vibrating said carrier and the spikes carried thereby to

assist in spiking into and loosening the gound and comprising an eccentric fly wheel mounted on the carrier with the axis of the fly wheel extending longitudinally of the frame to impart up and down and sidewise vibratory motion to the spikes, and means for pivoting the frame about the wheels to elevate the carrier and the spikes for transportation, and said floating connection permitting movement of the spikes into and out of the ground substantially along their axes to prevent tearing of the ground.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 20,663	Cameron	Mar. 1, 1938
2,068,828	Tustain	Jan. 26, 1937
2,517,733	Takats	Aug. 8, 1950
2,601,752	Rose	July 1, 1952
2,613,582	Harshberger	Oct. 14, 1952
2,641,982	Harshberger	June 16, 1953

FOREIGN PATENTS

441,228	Great Britain	Jan. 1, 1936