Sept. 22, 1959 A. R. HENRY 2,905,168

PAVEMENT BREAKING DRILL

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Fig. 1

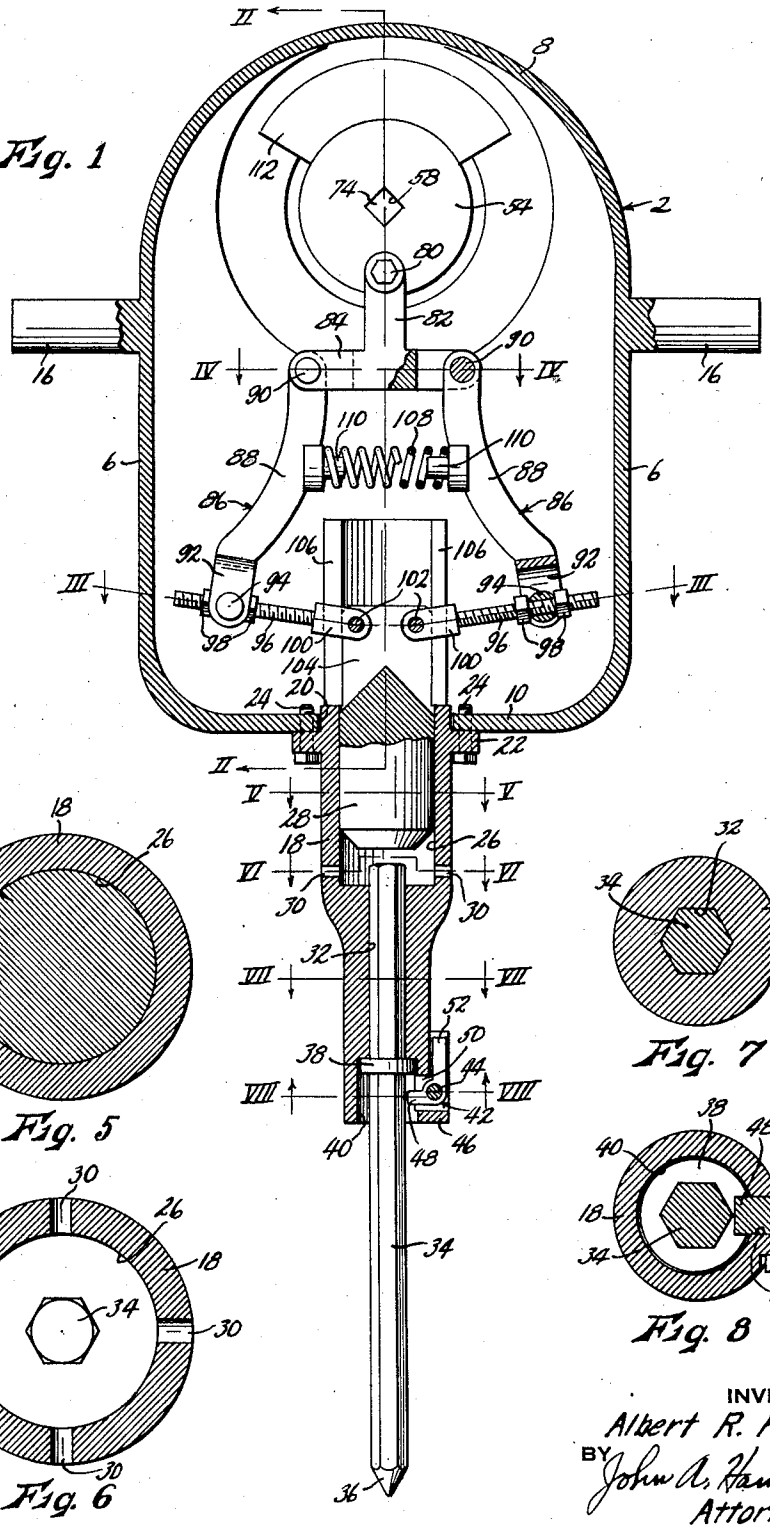


Fig. 5

Fig. 7

Fig. 6

Fig. 8

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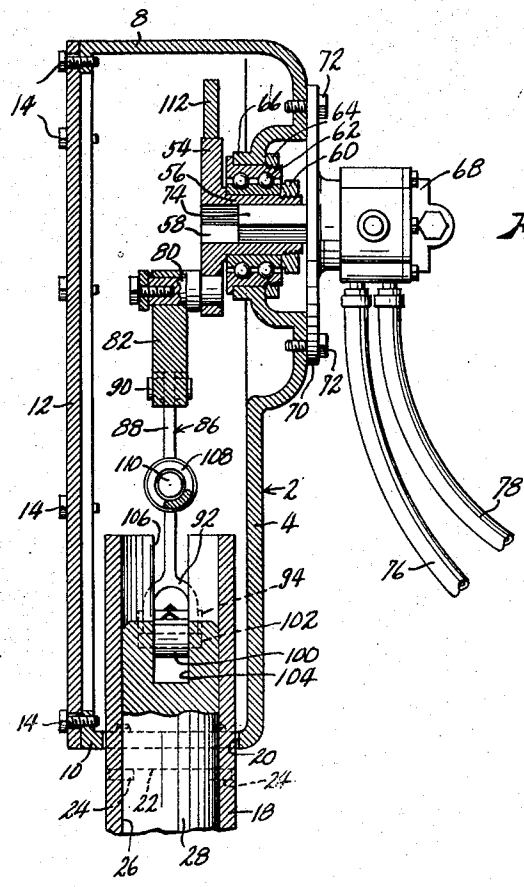


Fig. 2

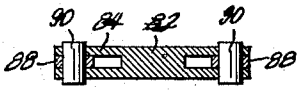


Fig. 4

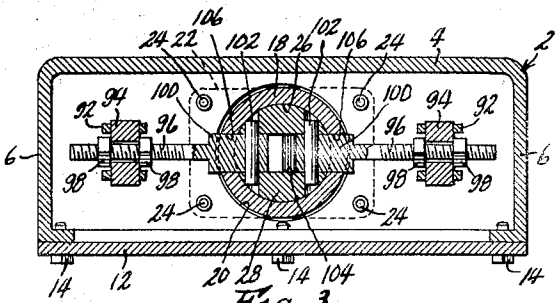


Fig. 3

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PAVEMENT BREAKING DRILL

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Application February 19, 1958, Serial No. 716,129

9 Claims. (Cl. 125—33)

This invention relates to new and useful improvements in pavement breaking drills or hammers, and has particular reference to drills or hammers of the power operated type.

A principal object of the present invention is the provision of a pavement breaking drill of the general class described having a heavy striker which is oscillatable in a housing to strike the drill bit at each oscillation to drive said bit against and into the pavement or other material against which it is pressed, power means for oscillating said striker, and a novel connection between said power means and said striker which is spring cushioned at all times and which is substantially inoperative or disconnected at the moment of impact between the striker and bit, whereby the reactive force of the blows is not transmitted back through the connection to the power means and housing and thence to the hands and arms of the operator. In this manner the power means, which may be a motor, is protected from shock damage to its bearings and operating parts, and the operation of the device is rendered less fatiguing to the operator.

Another object is the provision of a pavement drill of the class described adapted to be operated by a rotary prime mover such as a motor. Thus it is rendered peculiarly adaptable for electric or hydraulic operation, as distinguished from the more common piston-type pneumatic drills. My drill is thereby adapted to be powered by universally available electric current, or by the hydraulic system of the common farm tractor. This makes the equipment available to individual farmers and other person who could not justify the expense of the bulky air compressing equipment required for pneumatic drills.

Other objects are simplicity and economy of construction, efficiency and dependability of operation, and adaptability of the principles involved for use in other types of apparatus for delivering hammer blows.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the drawing, wherein:

Fig. 1 is a vertical sectional view through a pavement breaking drill embodying the present invention, with parts left in elevation and parts broken away,

Fig. 2 is a fragmentary sectional view taken on line II—II of Fig. 1,

Fig. 3 is a sectional view taken on line III—III of Fig. 1,

Fig. 4 is a sectional view taken on line IV—IV of Fig. 1, and

Figs. 5, 6, 7 and 8 are enlarged sectional views taken respectively on lines V—V, VI—VI, VII—VII, and VIII—VIII of Fig. 1.

Like reference numerals apply to similar parts throughout the several views, and the numeral 2 applies generally to a hollow housing having a back wall 4, side walls 6, a curved top wall 8, and a bottom wall 10. The front of said housing is normally closed by a cover plate 12 affixed thereto by screws 14. Said housing is also provided at each side thereof with an outwardly projecting handle 16 which may either be integral with or rigidly attached to side walls 6, and by means of which the drill may be positioned and manipulated during use. A cylindrical tubular barrel 18 extends through a circular hole 20 formed in bottom housing wall 10, said barrel being provided with an integral flange 22 which is rigidly secured to said bottom wall by screws 24. Said barrel extends well below housing 2, and also upwardly into said housing.

The upper portion of barrel 18 has a cylindrical internal bore 26 extending from the upper end of said barrel to a point below housing 2, and a heavy cylindrical striker 28 is carried for vertical sliding movement in said bore. The lower portion of bore 26 is vented to the atmosphere by holes 30 formed through the barrel wall, in order to prevent the formation of a vacuum or pressure in said bore as the striker moves upwardly and downwardly therein, as will be described. The lower portion of barrel 18 has a reduced internal bore 32 of hexagonal cross-sectional shape in which is slidably mounted the upper portion of a hexagonal drill bit 34. Said drill bit extends well below barrel 18, and is pointed at its lower end as indicated at 36 for easier penetration into pavement and the like. The upper end of the bit extends into the lower portion of cylindrical bore 26 whereby it may be struck by striker 28. Upward movement of the bit is limited by a flange 38 formed integrally therewith and engaging in a counterbored recess 40 formed in the lower end of the barrel. Downward movement of the bit is limited, and the bit is retained on assembly with the barrel, by a lever 42 secured by screw 44 between lugs 46 integral with the barrel. Said lever has an arm 48 which projects inwardly through a slot 50 formed in the barrel to a point beneath bit flange 38, and an arm 52 which which extends upwardly and rests against the outer surface of the barrel. The lever may obviously be tilted or removed to permit removal and replacement of the bit. The amount of longitudinal movement of the bit relative to the barrel caused by each blow of striker 28 is less than the spacing between flange 38 and lever arm 48, so that the force of the blows is not transmitted to said lever arm.

In the upper portion of housing 2, above the upper end of barrel, a disc 54 is mounted for rotation on an axis at right angles to the axis of the barrel, said disc having a hub 56 through which is formed a bore 58 of square cross-sectional shape. Said hub is secured by a nut 60 in a ball bearing 62, said bearing in turn being secured by nut 64 in a bushing 66 formed integrally with the housing. A hydraulic motor 68 is disposed externally of the housing, and is provided with a flange 70 which is secured rigidly to the housing as by screws 72. The output shaft 74 of said motor is squared, and projects slidably but non-rotatably into square bore 58 of hub 56, whereby operation of said motor will cause rotation of disc 54. Hydraulic fluid is conveyed to and from motor 68 through a pair of flexible hoses 76 and 78, which it will be understood may be connected operably into the hydraulic system of an ordinary farm tractor, not shown. The motor may also be furnished with suitable valving, also not shown, for controlling and regulating the flow of fluid thereto. It will be understood also that an electric motor or other suitable rotary prime mover could be used in place of the hydraulic motor.

A pivot pin 80 is fixed in disc 54 in parallel but offset relation from the axis of said disc. The upper end of an inverted T-shaped connector 82 is pivoted on pin 80, the cross bar 84 of said connector extending horizontally parallel to the face of the disc. Said connector is joined to striker 28 by a pair of opposed toggles 86, each of said toggles including a link 88 pivoted at its upper end to connector cross bar 84 at one end thereof by a pivot

pin 90 and extending downwardly therefrom, having a yoke 92 at the lower end thereof. A pivot pin 94 is journalled rotatably in the arms of yoke 92. The second link of each toggle is formed by a threaded rod 96 the outer end portion of which extends transversely through pivot pin 94, and is secured adjustably therein by a pair of nuts 98 threaded on said rod respectively at opposite sides of the pivot pin. The inner end of threaded rod 96 is provided with a head 100 which is pivoted in the upper end portion of striker 28 by a pivot pin 102. Heads 100 operate in a diametric slot 104 formed in the striker and in a pair of slots 106 formed at diametrically opposite sides of barrel 18. Pivot pins 90, 94 and 102 are all parallel to each other and to the axis of disc 54. A helical compression spring 108 extends horizontally between toggle links 88, the ends of said spring being retained on positioning lugs 110 affixed respectively to said toggle links. Said spring urges links 88 away from each other, whereby links 96 are urged to a position extending substantially oppositely from the striker, as shown in Fig. 1, whenever the device is at rest. It will be apparent that whenever the striker moves either upwardly or downwardly from the position shown, relative to the toggles 86, spring 108 will be compressed. A counterweight 112 affixed to disc 54 diametrically opposite from pivot pin 80 serves to balance partially the weight of the parts supported by said pivot pin, and hence to promote smoother operation with less vibration and "bucking" of the drill in the operator's hands.

The operation of the device is substantially as follows: Referring to Fig. 1, it will be seen that toggles 86 are disposed in what may be termed a "neutral" position when toggle links 96 extend oppositely from the striker in linear alignment with each other. In this position the toggle links 88 are spaced apart a maximum distance, and movement of the striker either upwardly or downwardly with respect to the toggles will cause links 88 to be drawn closer together to compress spring 108. As disc 54 is turned by operation of hydraulic motor 68 from the position shown in Fig. 1, pivot 82 carried by said disc of course moves alternately upwardly and downwardly, and acting through connector 82 and toggles 86, causes striker 28 to move upwardly and downwardly in barrel 18. During the upward movement of pivot 80, the inertia of striker 28 causes it to lag behind the actual elevation of pivot 80, with the result that toggles 86 are partially extended and spring 108 is compressed, and will remain compressed so long as its tension is balanced by the accelerative force imparted to the toggles by pivot 80, or until pivot 80 rises approximately to the elevation of the axis of disc 54. As pivot 80 then rises to the top of its movement, its vertical acceleration is of course negative, with the result that spring 108 is allowed to recover causing retraction of toggles 86 and delivering an upward impulse to the striker. This impulse adds to the upward momentum of the striker already induced by direct action of the toggles, so that as pivot 80 reaches the top of its travel and starts its downward movement, the striker continues upwardly by its own momentum, moving toggle links 96 above their neutral position and again forcing links 88 inwardly to compress spring 108, whereby the kinetic energy of said striker is stored in said spring as potential energy. The spring remains compressed during downward acceleration of pivot 80, or approximately until pivot 80 is again lowered to the level of the axis of disc 54. At this time the striker is being forced downwardly at the full maximum velocity of pivot 80, and toggles 86 are folded to compress spring 108. As pivot 80 passes below the axis of disc 54 and its acceleration becomes negative, spring 108 is allowed to recover, whereby its energy is released to deliver an added downward impulse to the striker. It will be seen from Fig. 1 that toggle links 96 pass their neutral position at or just before pivot 80 reaches its lowermost position, and that at this time the striker is just above the upper end of bit 34. The striker continues downwardly by its own momentum and strikes the bit which operates in the usual manner to drill into or break pavement or the like against which it is rested.

Since the striker engages the bit at a time that spring 108 is either fully extended or only very slightly compressed, and toggles 84 are substantially at their neutral positions, it will be seen that substantially the entire kinetic energy of the striker is available in the blow to the bit. Also for the reason that the toggles are substantially neutral at the moment of impact, the impact of the blow, or more properly the reaction from the blow will not be transmitted back through the linkage to the housing. The drill is thus rendered smoother and less fatiguing to the operator, in that the tendency of the drill to jerk and "buck" in the operator's hands is reduced. It will be readily apparent that the natural vibratory frequency of toggles 86 must correspond properly to the rate of rotation of disc 54, and this is accomplished by properly relating the mass of striker 28, the strength of spring 108, and the lengths and masses of toggle links 88 and 96. Minor adjustments may be made by loosening nuts 98 on toggle links 96 and moving said links through pivot pins 94 to adjust the lengths thereof.

While I have shown and described a specific embodiment of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention as defined by the scope of the appended claims, and it is accordingly desired that my patent protection extend to cover all subject matter falling properly within the scope of said claims.

What I claim as new and desire to protect by Letters Patent is:

1. A pavement breaking drill comprising a housing, a tubular barrel fixed in said housing and extending downwardly therefrom, an elongated drill bit carried for limited longitudinal sliding movement in said barrel and extending downwardly therefrom, a striker carried for sliding movement in said barrel and operable to strike the upper end of said bit, a driving member carried movably in the upper portion of said housing in spaced relation from the upper end of said barrel, power means carried by said housing and operable to reciprocate said drive member longitudinally with respect to said barrel, a toggle comprising a pair of links pivoted to each other and pivoted at their distal ends respectively to said drive member and said striker, and resilient means urging said links into relatively angled relation.

2. The structure as recited in claim 1 wherein at least one of the links in said toggle is adjustable in length, whereby to adjust the natural vibratory frequency of the toggle and striker supported thereby.

3. The structure as recited in claim 1 wherein said toggle has a neutral position in which one of the links thereof is disposed at right angles to the axis of movement of said striker, and wherein said resilient means urges said toggle yieldably at all times toward said neutral position.

4. The structure as recited in claim 1 wherein said toggle has a neutral position in which one of the links thereof is disposed at right angles to the axis of movement of said striker, and wherein said resilient means urge said toggle yieldably at all times toward said neutral position, the parts being so proportioned that when said driving member is at its lowermost position and said toggle is in its neutral position, said striker will be disposed just above the upper end of said drill bit.

5. The structure as recited in claim 1 wherein said power means includes a rotary member carried by said housing for rotation on an axis at right angles to the axis of said barrel, said driving member being pivoted to said rotary member eccentrically to the axis thereof, and a rotary motor mounted on said housing and operable to drive said rotary member.

6. The structure as recited in claim 1 wherein said

power means includes a rotary member carried by said housing for rotation on an axis at right angles to the axis of said barrel, said driving member being pivoted to said rotary member eccentrically to the axis thereof, and a rotary hydraulic motor mounted on said housing and furnished with hydraulic fluid through flexible hoses, said motor being operable to turn said rotary member.

7. The structure as recited in claim 1 wherein is incorporated a pair of said toggles in opposed relation.

8. The structure as recited in claim 1 wherein is incorporated a pair of said toggles in opposed relation, each of said toggles having a neutral position in which one of the links thereof extends at right angles to the barrel axis while the other link extends angularly to said barrel axis, and wherein said resilient means comprises a compression spring disposed between said angularly disposed links.

9. The structure as recited in claim 1 wherein is incorporated a pair of said toggles in opposed relation, wherein said driving member constitutes an inverted T-shaped connector to the ends of the cross arm of which the upper links of said toggles are respectively pivoted, and wherein said power means includes a disc carried by said housing for rotation on an axis at right angles to the barrel axis, the upwardly extending leg of said T-shaped connector being pivoted to said disc eccentrically to the axis thereof.

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