Nov. 13, 1962 A. R. HENRY 3,063,508

PAVEMENT BREAKING DRILL

Filed July 6, 1959 2 Sheets-Sheet 1

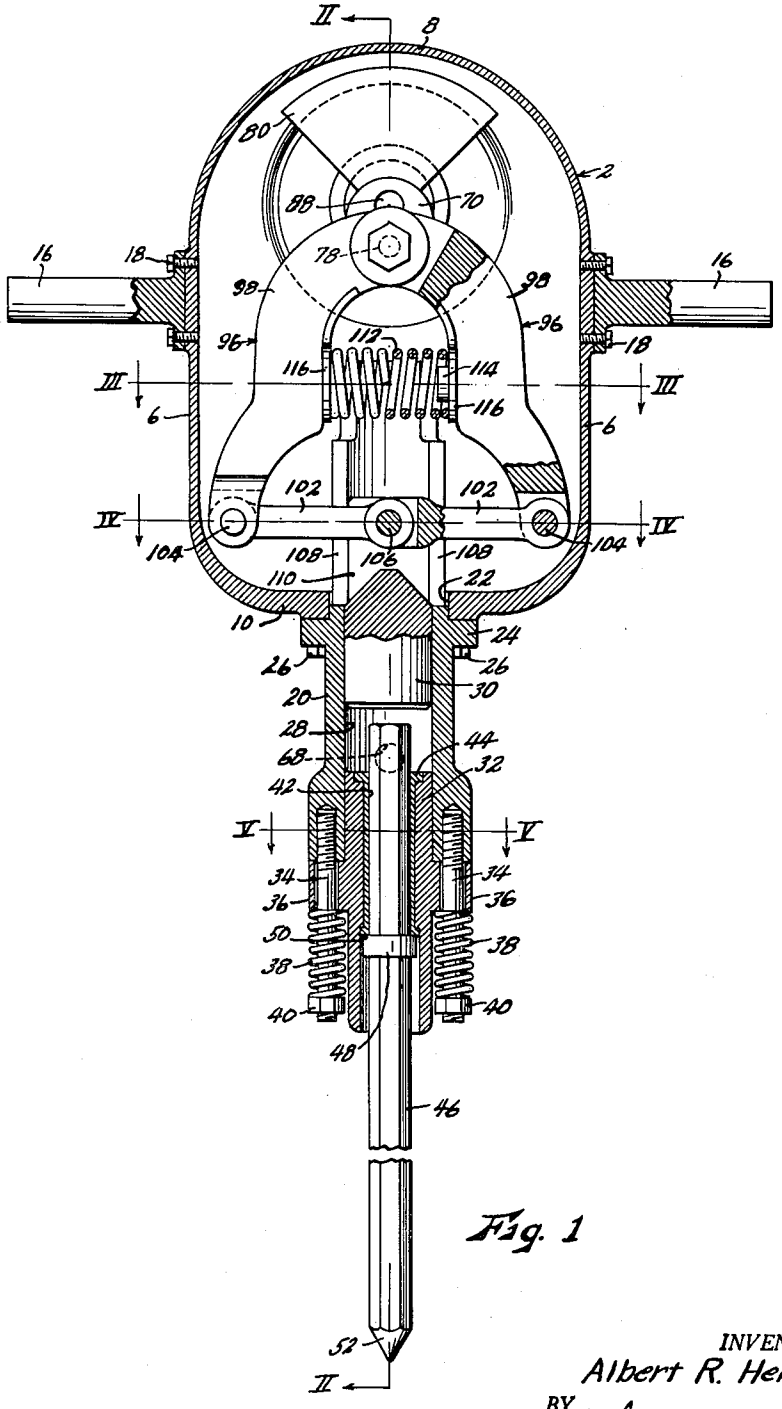


Fig. 1

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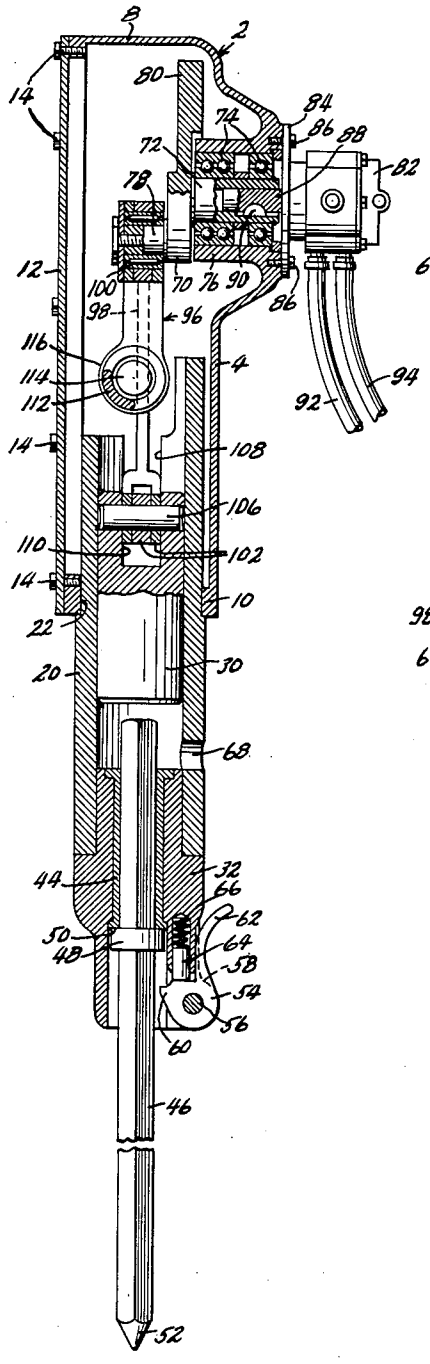


Fig. 2

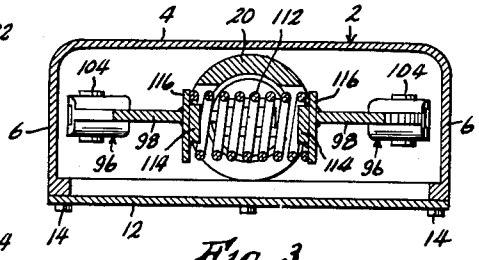


Fig. 3

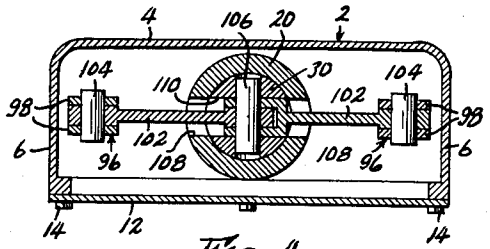


Fig. 4

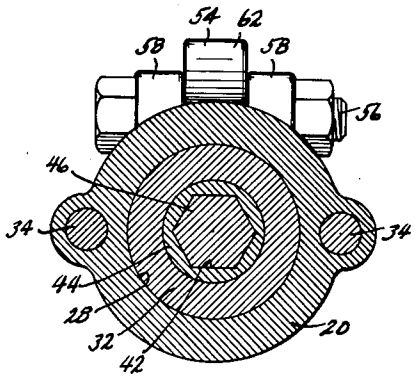


Fig. 5

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PAVEMENT BREAKING DRILL

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6 Claims. (Cl. 175—147)

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. It pertains to improvements over the device disclosed in my co-pending application Serial No. 716,129, now Patent 2,905,168, filed February 19, 1958, and entitled "Pavement Breaking Drill."

My prior structure involved a drill of the general class described having a heavy striker oscillatable in a housing to strike the upper end of a drill bit also carried by said housing to drive said bit against and into the pavement or other material against which it is pressed, a drive member rotatably driven in a plane parallel to the movement of the striker, and a novel means connecting the drive member to the striker. This connecting means, which formed the primary subject matter of my prior application, constituted a T-shaped connector having the upright leg thereof pivoted rotatably on the drive member, which constituted a crank, and a pair of opposed toggles each consisting of an upper link pivoted to one end of the cross arm of the T-connector, and a lower link pivoted to the upper link at one end and to the striker at its opposite end. The two upper links were thus pivoted to the connector at spaced apart points, and the two lower links were likewise pivoted to the striker on spaced apart axes. A compression spring was disposed between the two upper links and tended to urge them apart whereby to urge the two lower links into an axially aligned relation at right angles to the direction of striker travel. This was termed a "neutral" position, movement of the striker in either direction therefrom causing compression of the spring, and the parts were so proportioned that this neutral position occurred just before impact of the striker against the bit as the device was operated by rotation of the drive crank. This structure possessed certain advantages. The spring cushioned the action of the striker at all times, slowed the upstroke of the striker and in so doing stored potential energy therein, and delivered this potential energy in the form of added momentum to the striker during its downward or operative stroke. Also, since the neutral position of the toggles occurred substantially at the moment of impact, the reactive force of the blow was not transmitted back through the linkages to the drive member and housing, and hence not to the arms and shoulders of the operator. This protected many parts from shock damage and wear, and permitted use with much less fatigue to the operator.

However, the structure above described had certain weaknesses. For example, since the toggle ends were attached on separate pivotal axes which were spaced apart, and since the drive crank of course had a circular motion, the two toggles were extended and retracted unequally during certain portions of each crank rotation. Due to this unequal toggle action, the compression spring between the upper toggle links was not only alternately compressed and relaxed as desired, but also the ends thereof were moved out of axial alignment, so that the spring was subjected to lateral deflection or bending stresses. At the ordinary crank speed of perhaps 1500–2000 r.p.m., this lateral deflection caused rapid fatigue failure of the spring, necessitating frequent repair or replacement. Also, the T-connector was subject to a certain degree of random and uncontrolled oscillation about its connection to the drive crank, and this not only further contributed to the lateral deflection of the spring, but

also produced a lack of equality of the action of the toggles which caused a vibration or roughness in operation. The present invention has as its principal object the elimination of these difficulties, which it accomplishes in the main by eliminating the independently movable connector between the toggles and the crank, by pivoting the upper links to the crank coaxially with each other, and by pivoting the lower links to the striker coaxially with each other. Any one of these changes would reduce the difficulties recited. Together they produce two toggles which can never be flexed unequally, but which are always disposed symmetrically with respect to the plane containing their end pivots, regardless to their degree of flexing. Hence the ends of the spring cannot be misaligned, and the spring cannot be laterally deflected.

Other objects are simplicity and economy of construction, efficiency and dependability of operation, and freedom from excessive servicing requirements.

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 sectional view taken on line II—II of FIG. 1, with parts left in elevation and parts broken away,

FIGS. 3 and 4 are sectional views taken respectively on lines III—III and IV—IV of FIG. 1, and

FIG. 5 is an enlarged sectional view taken on line V—V 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** attached to side wall **6** by screws **18**, and by means of which the drill may be positioned and manipulated during use. A cylindrical tubular barrel **20** extends through a circular hole **22** formed in bottom housing wall **10**, said barrel being provided with an integral flange **24** which is rigidly secured to said bottom wall by screws **26**. Said barrel extends well below housing **2**, and also upwardly into said housing.

Barrel **20** has a cylindrical internal bore **28** from end to end, and a heavy cylindrical striker **30** is carried for vertical sliding movement in the upper portion thereof. A drill chuck **32** of essentially tubular form is inserted slidably into the lower end of the barrel and retained therein by a pair of bolt studs **34** extending loosely through lugs **36** of said chuck and threaded into said barrel. A compression spring **38** is carried on each stud between lug **36** and a nut **40** threaded on said stud, whereby the chuck is retained yieldably in position. The chuck has an internal bore **42** of hexagonal cross-sectional shape, being provided with a hardened, wear-resistant liner **44**. A hexagonal drill bit **46** is carried for axial sliding movement in bore **42**, said bit having an integral flange **48** which engages a shoulder **50** formed by the lower end of insert **44**. Said bit extends well below chuck **32** and is provided with an operative point **52** of any desired design, and extends at its upper end above chuck **32** into bore **28** of barrel **20**. The bit is retained loosely in the chuck by a lever **54** (see FIG. 2) pivoted by means of bolt **56** between lugs **58** integral with the chuck. Said lever is provided with a tooth **60** which projects inwardly to a point beneath bit flange **48**, whereby to prevent withdrawal of the bit, and a handle **62** which may be operated to withdraw tooth **60** from beneath flange **48** to permit withdrawal of the bit. The lever is normally retained in its operative position by a detent pin **64** carried by the chuck

and urged against the lever by a spring 66. Barrel 20 has a vent hole 68 formed therein just above the chuck, whereby to prevent the formation of a vacuum or pressure within the barrel when the striker is reciprocated therein as will be described.

In the upper portion of housing 2, above the upper end of barrel 20, a disc 70 constituting a crank arm is carried for rotation by a hollow shaft 72 which extends horizontally at right angles to the extended axis of barrel 20, and which is supported rotatably by ball bearings 74 in a tubular bushing 76 formed integrally with back wall 4 of the housing. Disc 70 has affixed thereto a forwardly projecting crank pin 78 which is parallel to but eccentrically offset from shaft 72. A counterweight 80 is formed integrally with disc 70, at a point thereof diametrically opposite from crank pin 78.

A hydraulic motor 82 is provided with a flange 84 which is secured to the housing wall 4 by screws 86 so as to cover the outer end of bushing 76. The output shaft 88 of said motor extends into hollow shaft 72, and the two shafts are secured against relative rotation by a key 70. Hydraulic fluid is supplied to and from motor 82 by a pair of flexible conduits 92 and 94, which it will be understood may be connected operably into the hydraulic system of an ordinary farm tractor, or to any other suitable source of fluid under pressure. It will be understood also that the motor may be provided with suitable control valving, operable by the user to control the motor. Such valving is not here shown as it forms no part of the present invention.

Crank pin 72 is connected to striker 30 by a pair of opposed toggles each indicated generally by the numeral 96. Each of said toggles, as best shown in FIGS. 1 and 2, consists of an upper link 98, pivoted on crank pin 78 by means of a needle bearing 100, and a lower link 102 pivoted at one end to the lower end of link 98 by a pivot pin 104, and pivoted at its opposite end to striker 30 by means of a pivot pin 106, both of links 102 being attached to the single pivot pin 106. Barrel 20 has longitudinal slots 108 formed in the upper portion thereof to admit links 102, and said links project into a diametric slot 110 formed in the upper end portion of the striker. A helical compression spring 112 extends horizontally between toggle links 98 intermediate their ends. Each end of said spring is located by a boss 114 affixed to a pressure plate 116 welded to one of links 98. Said spring urges links 98 away from each other, whereby links 102 are urged to a position extending substantially oppositely from each other, whenever the device is at rest. This may be termed a "neutral" position, and occurs, as shown in FIG. 1, when crank pin 78 is in its lowermost position and striker 30 is just above the upper end of bit 46. Whenever striker 30 moves either upwardly or downwardly from this neutral position relative to the toggles, spring 112 must be compressed. Counterweight 80 serves to balance at least partially the weight of the parts supported by crank pin 78, and hence to promote smoother operation with less vibration and with less "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 96 are disposed in their "neutral" positions when lower toggle links 102 extend oppositely from striker pivot 106 in linear alignment with each other. In this position upper toggle links 98 are spaced apart a maximum distance, and movement of the striker either upwardly or downwardly with respect to the toggles will cause links 98 to be drawn closer together to compress spring 112. As crank disc 70 is turned by hydraulic motor 82 from the position shown in FIG. 1, crank pin 78 carried by said disc of course moves alternately upwardly and downwardly, and acting through the toggles, causes striker 30 to move upwardly and downwardly in barrel 20. During the upward movement of pin 78, the inertia of striker 30 causes it to lag behind the actual elevation of pin 78, with the result that toggles 96 are partially extended and spring 112 is compressed, and will remain compressed so long as its tension is balanced by the accelerative force imparted to the toggles by pin 78, or until pin 78 rises approximately to the elevation of the axis of disc 70. As pin 78 then continues to the top of its movement, its vertical acceleration is of course negative, with the result that spring 112 is allowed to recover, thereby causing retraction of toggles 96 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 78 reaches to top of its travel and starts its downward movement, the striker continues upwardly by its own momentum, moving toggle links 102 above their neutral position and again forcing links 98 inwardly to compress spring 112, whereby the kinetic energy of said striker is stored in said spring as potential energy. The spring remains compressed during downward acceleration of pivot 78, or approximately until pivot 78 is again lowered to the level of the axis of disc 70. At this time the striker is being forced downwardly at the full maximum velocity of pivot 78, and toggles 96 are folded to compress spring 112. As pivot 78 passes below the axis of disc 70 and its downward acceleration becomes negative, spring 112 is allowed to recover, whereby its energy is released to deliver an added downward impulse to the striker. It will be seen in FIG. 1 that links 102 pass their neutral position at or just before pivot 89 reaches its lowermost position, and that at this time the striker is just above the upper end of bit 46. 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 112 is either fully extended or only very slightly compressed, and toggles 96 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 toggle linkages to the housing. The drill is thus rendered smoother in operation and less fatiguing to the operator, in that the tendency of the drill to jerk and "buck" in the operator's hands is reduced.

The structure which has been described is similar to that disclosed in my above identified prior application, except that in the prior structure the upper toggle links 98, in place of being pivoted coaxially to pin 78, were pivoted respectively at spaced apart points to the ends of the cross arm of an inverted T-shaped connector, the upright leg of which was in turn pivoted to a crank pin corresponding to crank pin 78 in the present structure; and with the difference also that in the prior structure the lower toggle links 102 were pivoted to the striker on horizontally spaced apart axes, rather than coaxially as in the present structure. These three changes, namely pivoting the lower links coaxially to the striker, pivoting the upper links coaxially, and the elimination of the connector intermediate the upper links and the pin, constitute the improvements of the present invention.

With the upper links and the lower links pivoted respectively to the crank and the striker on spaced apart axes, as in the prior structure, it will readily be apparent that due to the rotary motion of the crank pin the two toggles were flexed unequally at all times except at the top and bottom dead-center positions of the crank, and that the degree of this inequality was continuously changing at a high rate of speed. For this reason, the two ends of spring 112 were continuously being moved into and out of axial alignment, thus subjecting the spring to a rapid or vibrating lateral or bending deflection. This resulted in a much less smooth operation than is obtain-

able with the present structure, and caused rapid fatigue of the spring, necessitating frequent repair or replacement thereof. Also, it was found that the connector between the upper links and the crank pin often oscillated about the crank pin in a more or less random and uncontrolled manner, which also created roughness and vibration in operation, and increased the frequency and magnitude of the lateral flexing to which the spring was subjected. Any one of the three changes enumerated above would partially correct these difficulties, the elimination of the intermediate connector preventing any uncontrolled movement of the upper toggle pivot, and making either the upper toggle pivots or the lower toggle pivots coaxial tending to reduce any inequalities of flexing of the two toggles. With both the upper and lower toggle pivots coaxial, the two toggles must always be symmetrically disposed with respect to a plane including the axes of crank pin **78** and pivot pin **106**, and hence the two toggles cannot be flexed unequally at any time. Hence the end mounting bosses **114** of spring **112** cannot be moved out of alignment with each other, and the spring itself is hence never subjected to lateral bending. This structure has been found to contribute substantially to the efficiency of operation of the device, both in that the spring **112** is caused to have a much longer effective life, and in that the mechanism operates much more smoothly with less vibration, thereby providing operation which is considerably less tiring to the operator and in which the motor and toggle bearings are subjected to less wear.

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.

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 drive member constituting a crank carried in the upper portion of said housing in spaced relation above the upper end of said barrel, said crank being rotatable on an axis at right angles to the extended axis of said barrel and including a crank pin disposed eccentrically to the crank axis, means for rotating said crank, a pair of opposed toggles each comprising an upper link and a lower link pivotally joined at their contiguous ends, the opposite ends of said lower links being pivoted to said striker, connecting means pivotally

joining the opposite ends of said upper links together in coaxial relationship, said pivotal connecting means being pivoted to said crank pin for rotation thereon, and a compression spring extending between and connected at its opposite ends respectively to said two upper links, whereby to urge said upper links away from each other.

2. The structure as recited in claim 1 wherein said pivotal connecting means is pivoted to said crank pin on an axis coaxial with the pivotal connection of said upper toggle links to said connecting means.

3. The structure as recited in claim 1 wherein said upper toggle links are pivotally mounted on said crank pin in coaxial relation with each other.

4. 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 drive member constituting a crank carried in the upper portion of said housing in spaced relation above the upper end of said barrel, said crank being rotatable on an axis at right angles to the extended axis of said barrel and including a crank pin disposed eccentrically to the crank axis, means for rotating said crank, a pair of opposed toggles each comprising an upper link and a lower link pivotally joined at their contiguous ends, the opposite ends of said lower links being pivoted coaxially to said striker, connecting means pivotally joining the opposite ends of said upper toggle links to said crank pin, and a compression spring extending between and connected at its opposite ends respectively to said two upper links.

5. The structure as recited in claim 4 wherein said connecting means connects said upper links for relative movement about a common axis, and is itself mounted pivotally on said crank pin.

6. The structure as recited in claim 4 wherein said connecting means connects said upper links for relative movement about a common axis, and is itself mounted pivotally on said crank pin, so that the axis of said crank pin coincides with the pivotal axis of said upper links.

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