Oct. 14, 1952 H. C. REYNOLDS 2,613,662

ROTARY DRIVEN PERCUSSIVE TOOL

Filed March 21, 1950

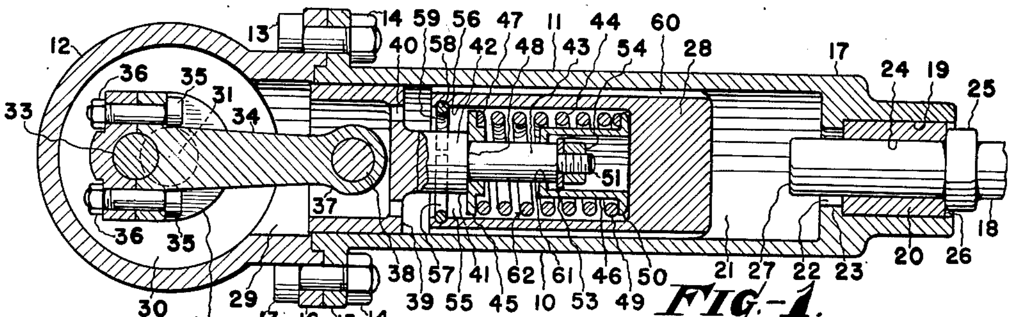

FIG-1.

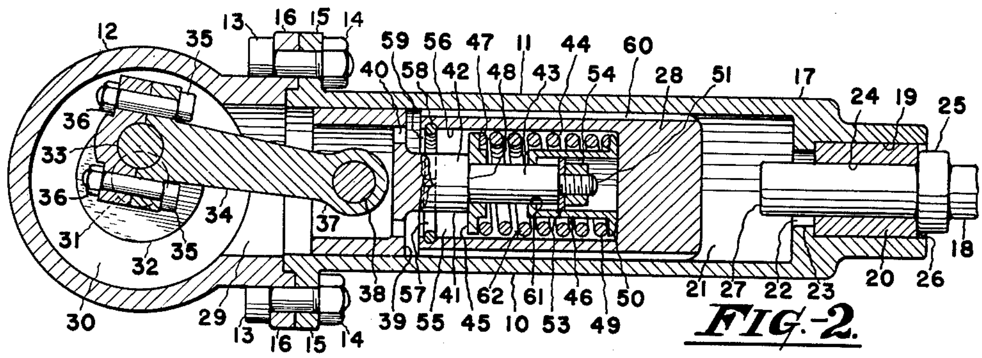

FIG-2.

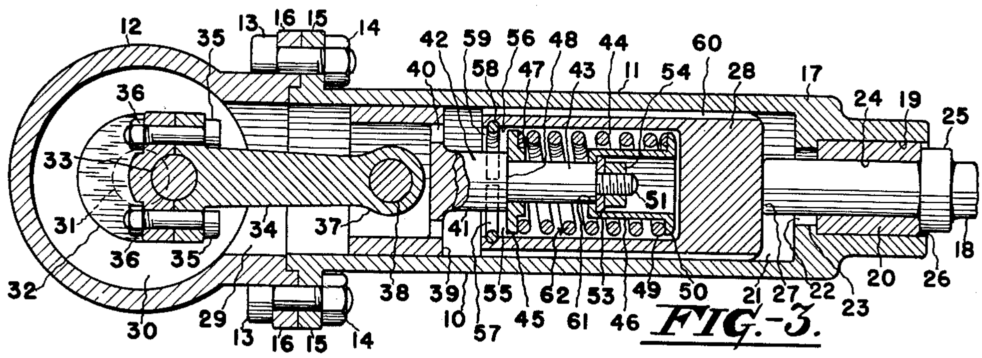

FIG-3.

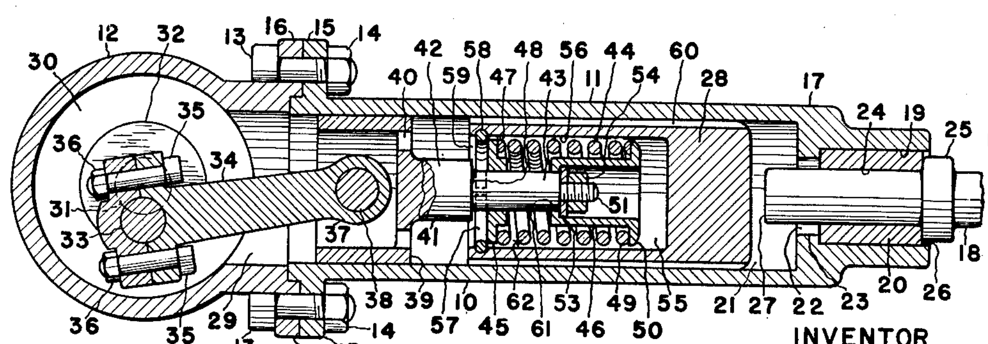

FIG-4.

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Patented Oct. 14, 1952 2,613,662

UNITED STATES PATENT OFFICE

2,613,662

ROTARY DRIVEN PERCUSSIVE TOOL

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Application March 21, 1950, Serial No. 151,008

10 Claims. (Cl. 125—33)

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This invention relates to percussive tools, and more particularly to percussive tools having a rotary drive.

One object of the invention is to provide a percussive tool with a rotary drive mechanism.

Another object of the invention is to isolate the rotary element of the tool from the shock of the percussive impact.

Another object is to provide a simple and compact cushioning mechanism for the tool.

Still another object of the invention is to provide a construction which will insure long life of the cushioning element.

Other objects will be in part obvious and in part pointed out hereinafter.

In the drawings in which identical reference numbers refer to similar parts,

Figure 1 is a longitudinal view, partly in section, showing the positions which some of the parts of the tool occupy when the drive shaft is in the top dead center position,

Figure 2 is a view similar to Figure 1 showing the positions of the parts 90° after top dead center,

Figure 3 is a similar view showing the positions of the parts at the moment the percussive element strikes the working implement, and

Figure 4 is a similar view showing the positions of the tool parts 90° before top dead center position of the drive shaft.

Referring now to the drawings for a detailed description of the invention and, at first, more particularly to Figure 1, the tool, shown as a preferred form of the invention, comprising a driving element, which may be any suitable motor (not shown) having a rotating drive shaft, a percussive element for striking a working implement a series of blows, and suitable means for converting the rotary motion of the drive shaft into reciprocable movement of the percussive element.

The tool casing **10** comprises a cylinder barrel **11** and a motor housing **12** joined together by bolts **13** and nuts **14** at the flanges **15—16**. At its forward end **17** the cylinder barrel **11** is adapted to receive a working implement **18** and to this end a recess **19** is provided in the cylinder barrel **11** having a bushing **20** inserted therein. The recess **19** communicates with a chamber or cylinder **21**, formed within the cylinder barrel **11**, through an aperture **22** in the casing wall **23** between the recess **19** and the cylinder **21**.

A working implement **18** is inserted into the bore **24** of the bushing **20** and has a collar **25** to abut the outer end surface **26** of the bushing. The length of the working implement **18** from

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the collar **25** to its inner end **27** is such that when the collar abuts the bushing the end of the working implement projects through the aperture **22** and a sufficient distance into the cylinder **21** to enable a piston **28** reciprocating within the cylinder to strike the end **27**.

Any suitable means may be employed to convert the rotary movement of the driving element to reciprocable movement of the percussive element. In the form preferred by the applicant, the motor housing **12** is provided with a cylindrical opening **29** which forms a continuation of the cylinder **21** and opens into a chamber **30** housing the rotating drive shaft **31** of the motor. The drive shaft **31** has a circular plate **32** having a crank-pin **33** thereon arranged eccentrically with respect to the shaft **31**.

A connecting rod **34** is connected to the crank-pin at one end by bolts **35** and nuts **36** and has a free running fit on the crank-pin. At its opposite end **37** the connecting rod is joined, by a wrist pin **38**, to a crosshead **39** slidable on the inner surface of the cylinder **21**. The motion of the connecting rod **34** causes the crosshead **39** to reciprocate in the cylinder **21** and the air displaced as the crosshead reciprocates within the cylinder passes from one side to the other of the crosshead through ports **40** in the crosshead **39**.

Reciprocable motion is imparted to the piston **28** by the crosshead **39** through a resilient connection designed to allow the piston to have some independent forward movement with respect to the crosshead and provided with means for causing the piston to have such independent forward movement at the moment of impact with the working implement. In the form of the invention illustrated a spring assembly **62** is mounted on the crosshead **39** and a recess **55** is provided in the piston **28** to receive the assembly. The recess has a depth greater than the extended length of the spring **44** and this provides a certain amount of clearance at the ends of the spring enabling the piston to have free independent movement with respect to the spring assembly **62** and the crosshead **39**. Such independent movement is caused by the energy stored in the compression of the spring which imparts a velocity to the piston that carries it forwardly out of engagement with the spring to strike the working implement. Thus at the moment of impact the piston is completely free to move independently of the spring and crosshead.

More specifically, the resilient connection comprises a shaft or projection **41** on the crosshead **39** having two different diameters **42—43** and a coil spring 44 mounted on the smaller section 43 thereof. One end 47 of the spring 44 is confined by a circular disc 45 slidably mounted on the smaller section. Endwise movement of the disc 45 is limited by a shoulder 48 on the shaft 41 formed by the change in diameter.

The retainer 46 for the opposite end 49 of the spring 44 is a cup-shaped member having a flange 50 at its open end for engagement with the spring. An aperture 61 is provided in the bottom of the cup portion of the retainer which allows the retainer to be slidably mounted on the smaller section 43 of the shaft 41. The retainer 46 is held on the section 43 by means of a nut 54 and washer 53 threaded onto a stud 51 provided in the end of the projection 41, the diameter of the washer being greater than that of the aperture so that the washer 54 limits the endwise movement of the retainer. In the limited position of the retainer the end 49 of the spring 44 and the flange 50 of the retainer 46 extend beyond the end of the shaft 41 enabling the spring to be compressed considerably from that end before the stud in the end of the shaft limits the compression.

A recess 55 is provided in the piston 28 to receive the resilient connection and has a depth greater than the over-all length of the spring assembly 62. The recess 55 has a bore 56 slightly larger than the diameter of the spring and accommodates the entire spring assembly 62 within its confines. A metal snap ring 57 is inserted in a groove 58 at the mouth 59 of the recess 55 and when in place prevents the spring assembly from withdrawing from the recess in the piston. Longitudinally disposed grooves 60 in the periphery of the piston 28 allow the air in the cylinder 21 to transfer from one side of the piston to the other as the piston travels in the cylinder.

It will be noted that the spring may be compressed from either end and that such compression of the spring 44 is caused by the piston moving relatively to the crosshead. If the piston moves away from the crosshead the snap ring 57 engages the retainer 45 and compresses the spring from the upper end 47. If the piston moves toward the crosshead the bottom of the recess 55 in the piston engages the retainer 46 and compresses the spring from the lower end 49. However, the clearance provided between the recess and the spring assembly allows the piston to have some reciprocable movement independently of the crosshead and the spring assembly.

In the normal operation of the tool, the rotation of the drive shaft is converted to reciprocation of the crosshead as hereinbefore described. After the normal operating speed of the motor is reached the cycle of operation becomes stabilized and proceeds in a manner described below.

Referring now to Figure 4 the crosshead 39 is shown at a position 90° before the top dead center position and is at the mid point of its stroke travelling upwardly at its greatest velocity. The inertia of the mass of the piston 28 causes its movement to lag behind that of the crosshead and as a result the crosshead moves away from the piston until the snap ring 57 engages the circular disc 45. In the acceleration of the piston the spring 44 is compressed by the snap ring 57 and energy is stored therein. At the instant shown in Figure 4 the piston 28 is travelling upwardly with increasing velocity.

In Figure 1 the crosshead has reached the top dead center position. The piston 28, however, because of its inertia and because of the velocity imparted to it by the energy stored in the compression of the spring 44, continues in an upward direction, relieving the compression of the spring from the upper end 47, and compresses the spring 44 from the lower end 49, again storing energy therein.

The piston continues upwardly while the crosshead starts its downward travel and the spring continues to be compressed from the lower end. At a point between the top dead center position and 90° after top dead center the inertia of the piston is overcome and the piston's upward travel is halted. A maximum compression of the spring has occurred and the energy stored therein now begins to accelerate the piston downwardly.

Figure 2 shows the crosshead at the mid point of its downward stroke travelling at its greatest velocity. The piston 28, at this point, is travelling downwardly with increasing velocity. However, the velocity of the piston is not great enough at this time to allow the piston to move away from the crosshead to a point which would enable the spring to assume its unstressed position, consequently, the spring 44 is still compressed from its lower end 49.

In travelling from the position shown in Figure 2 to the bottom dead center position shown in Figure 3 the velocity of the crosshead decreases until the downward travel of the crosshead is halted. At the same time, the energy stored in the compression of the spring 44 increases the velocity of the piston 28 to a point where it exceeds the velocity of the crosshead. As a result there is relative movement of the piston away from the crosshead 39 until the piston reaches a point which allows the spring 44 to extend to its normal length. The energy stored in the compression of the spring has imparted a high velocity to the piston which now causes it to move independently of the crosshead and the spring and out of engagement therewith to strike against the working implement. Figure 3 shows the positions of the parts at the moment of impact between the piston and the working implement.

The weight of the piston, the stiffness of the spring and the frequency of the drive shaft revolutions are carefully selected so that the piston will disengage from the spring assembly just prior to the moment of impact with the working implement. As mentioned above, the depth of the recess 55 in the piston 28 is greater than the extended length of the spring 44. When the crosshead is at bottom dead center position the piston has reached a point which allows the spring 44 to be completely extended and is no longer in contact with the spring 44. The velocity of the piston causes it to continue downwardly and to strike the working implement a sharp blow while still disengaged from the spring 44. As a result the shock of impact is not transmitted to the spring 44 and consequently it has a much longer life.

After striking the working implement 18 the piston rebounds compressing the spring from its lower end. The velocity of the crosshead is now increasing and very quickly exceeds that of the rebounding piston. Inertia of the piston causes its movement to lag behind that of the crosshead, consequently, the spring 44 soon is fully extended and then compressed from its upper end by the piston as shown in Figure 4 whereupon the cycle of operation described above is repeated.

The length of the recess need not be greater than the length of the spring. It is possbile to employ many constructions having a recess of shorter length than the spring without departing from the spirit of the applicant's invention and it is to be understood that the foregoing description is merely illustrative of the preferred form of the applicant's invention and that the scope of the invention should not be limited thereto, but should be determined by the scope of the appended claims.

I claim:

1. A percussive tool comprising a casing having a chamber, a reciprocable member in the chamber, a working implement in the casing, a reciprocable piston in the chamber for striking the working implement actuated by said member and capable of independent forward movement with respect thereto, a resilient member for causing the piston to so move forwardly to strike the working implement, and a retainer for disengaging the resilient member from the piston before the piston strikes the working implement.

2. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a working implement, a reciprocable member in the chamber, means for converting the rotary motion of the drive shaft to reciprocable motion of the member, a reciprocable piston in the chamber for striking the working implement actuated by said member and capable of independent forward movement with respect thereto, a resilient member in the chamber for causing the piston to so move forwardly with respect to the member to strike the working implement, and a retainer cooperating with the resilient member to disengage the resilient member from the piston before the piston strikes the working implement.

3. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a working implement, a reciprocable member in the chamber, means for converting the rotary motion of the drive shaft to reciprocable motion of the member, a reciprocable piston in the chamber for striking the working implement actuated by said member and capable of independent forward movement with respect thereto, and a spring interposed between the reciprocable member and the piston for causing the piston to so move forwardly with respect to said member and to strike the working implement, and a retainer for disengaging the spring from the piston before the piston strikes the working implement.

4. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a working implement, a reciprocable member in the chamber, means for converting the rotary motion of the drive shaft to reciprocable motion of the member, a reciprocable piston in the chamber for striking the working implement actuated by said member and capable of independent forward movement with respect thereto, a spring in the chamber for causing the piston to so move forwardly with respect to said member, and means for preventing engagement of a retainer for the spring to prevent the spring with the piston at the moment the piston strikes the working implement.

5. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a working implement, a reciprocable member in the chamber, means for converting the rotary motion of the drive shaft to reciprocable motion of the member, a reciprocable piston in the chamber for striking the working implement connected to said member and capable of independent forward movement with respect thereto, a spring on the reciprocable member for causing the piston to so move forwardly with respect to the member and to strike the working implement, and a retainer cooperating with the spring to disengage the spring from the piston before the piston strikes the working implement.

6. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a reciprocable member in the chamber, means for converting the rotary motion of the drive shaft to reciprocable motion of the member, a working implement in the casing, a reciprocable piston in the chamber for striking the working implement, a spring mounted on the reciprocable member for causing the piston to strike the working implement, a recess in the piston to receive the spring, said recess having a length greater than the extended length of the spring to allow the piston to have some independent reciprocable movement with respect to the spring and a retainer for the spring to disengage the spring from the piston before the the piston strikes the working implement.

7. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a reciprocable member in the chamber, means for converting the rotary motion of the drive shaft to reciprocable motion of the member, a working implement in the casing, a reciprocable piston for striking the working implement capable of relative movement with respect to the reciprocable member, and a spring interposed between the reciprocable member and the piston adapted to be compressed from either end by the piston moving relatively to the reciprocable member and acting to cause the piston to strike the working implement.

8. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, means for converting the rotary motion of the drive shaft to reciprocable motion of the member, a working implement in the casing, a reciprocable piston in the chamber for striking the working implement, a spring interposed between the reciprocable member and the piston for causing the piston to strike the working implement, and surfaces on the piston for compressing the spring from one end thereof when the piston moves toward the reciprocable member and for compressing the spring from the other end of said spring when the piston moves away from the reciprocable member, said surfaces being spaced at a distance greater than the length of the spring.

9. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a crosshead in the chamber, a connecting rod connecting the crosshead to the drive shaft for converting the rotary motion of the shaft to reciprocable motion of the crosshead, a working implement in the casing, a reciprocable piston in the chamber for striking the working implement, a spring for causing the piston to strike the working implement mounted on the crosshead, and surfaces on the piston to compress the spring from either end, said surfaces being spaced at a distance greater than the extended length of the spring.

10. A percussive tool comprising a casing having a chamber therein, a rotary drive shaft in the chamber, a crosshead in the chamber, a connecting rod joining the crosshead to the drive shaft for converting the rotary motion of the

shaft to reciprocable motion of the crosshead, a working implement in the casing, a reciprocable piston in the chamber for striking the working implement, a projection on the crosshead, a spring interposed between the crosshead and the piston for causing the piston to strike the working implement, a pair of retainers for the spring slidably mounted on the projection, said retainers being slidable inwardly toward one another for compressing the spring, a recess in the piston to receive the spring, said recess having a length greater than the distance from one retainer to the other, and a ring removably mounted in the mouth of the recess to confine the spring therein.

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