United States Patent

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fractional part interest

[54] **POWER DRIVEN HAMMERS**
3 Claims, 4 Drawing Figs.

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[51] Int. Cl. B25d 11/00

[50] Field of Search 173/117, 119, 122, 124

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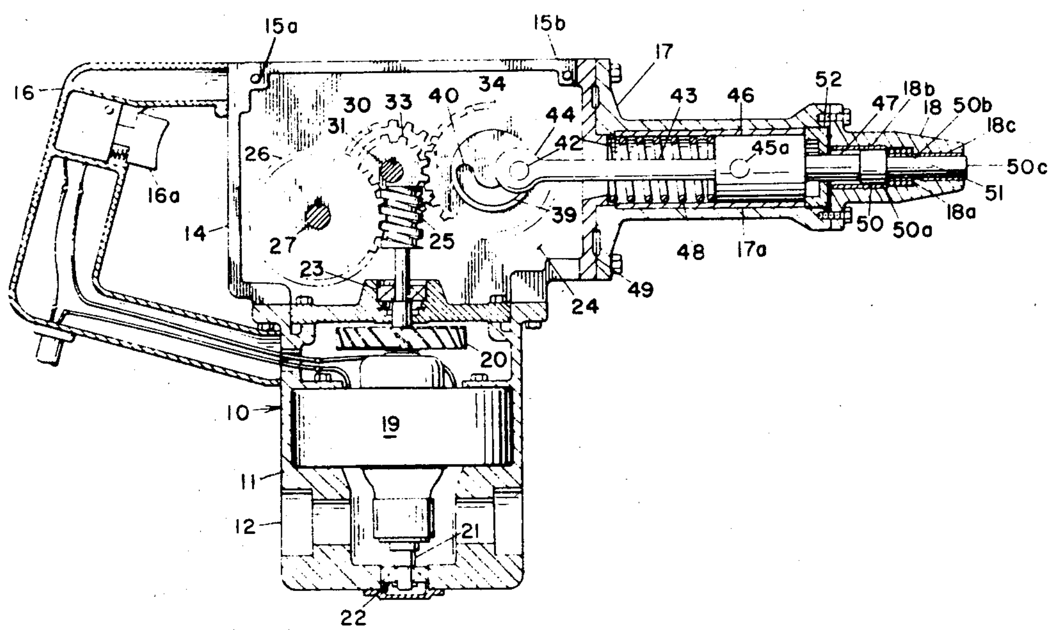
ABSTRACT: A portable electrically driven hammer for riveting and other uses. Quick-return reciprocal motion is imparted to a spring-biased piston by means of a connecting rod and attached crankpin which slidably engages an arcuate slot in a rotating gear. The quick-return motion of the piston is utilized to effect repeating, sharp hammer blows.



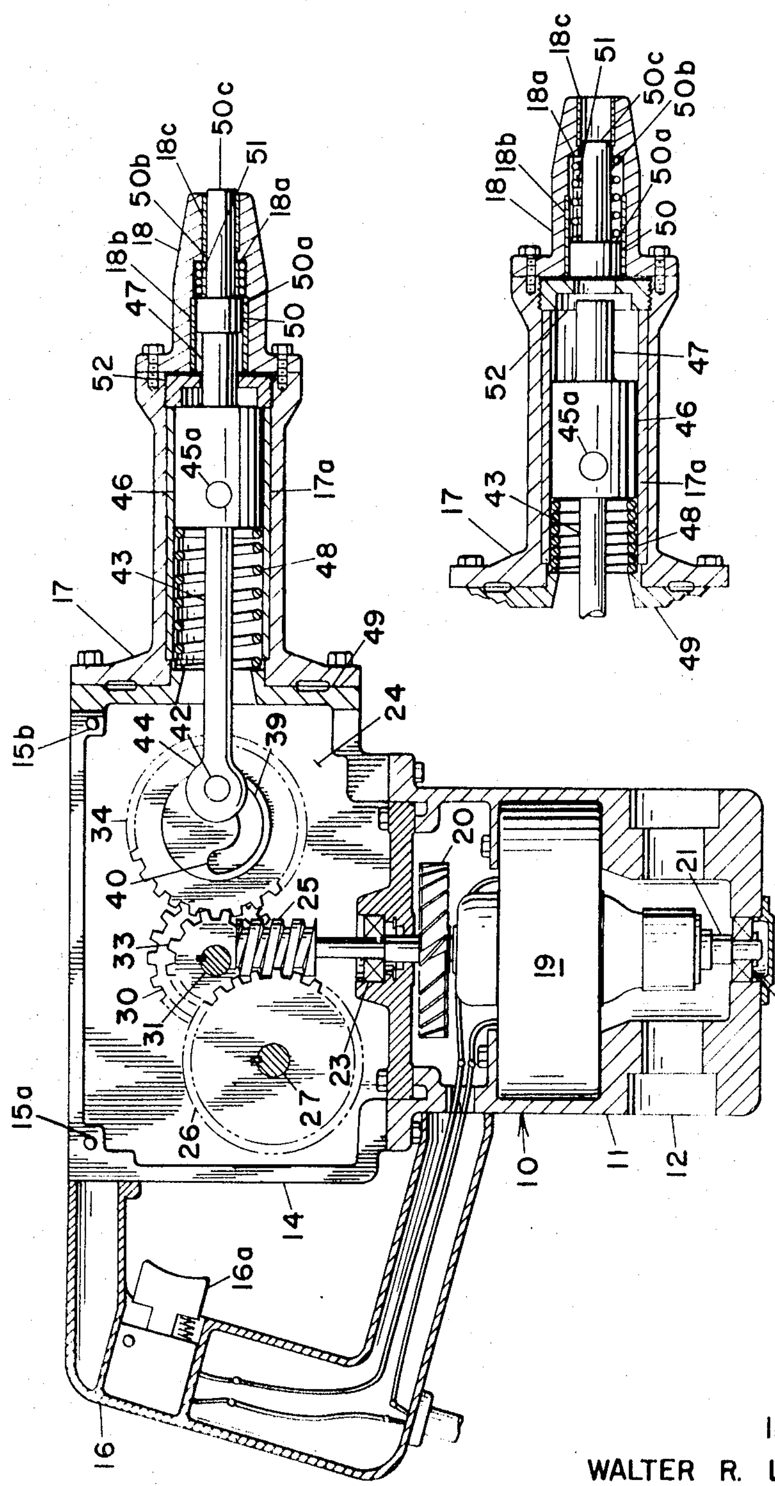


Fig. 3

Fig. 1

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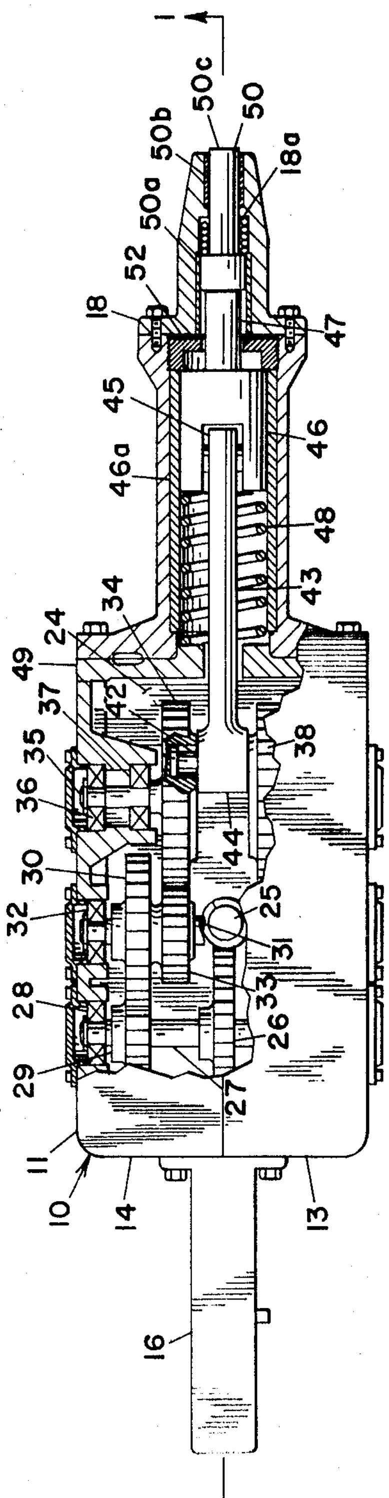

Fig. 2

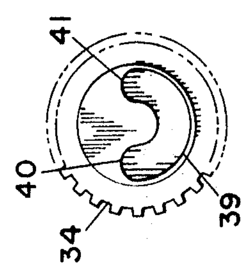

Fig. 4

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POWER DRIVEN HAMMERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a portable electric hammer for riveting and other uses.

2. Description of Prior Art

Various impact devices have been developed for use in riveting, nailing, stoneworking, concrete demolition, and the like. Such devices, which will be referred to herein as power hammers, have been driven by air pressure, internal combustion engines, and electrical means.

Electrical power has many advantages over air and internal combustion engines as a power source for power hammers. However, prior devices for converting the rotary motion of an electric motor shaft into the reciprocating motion required for a power hammer have had various disadvantages. Some of such devices have employed reciprocal mechanisms which were inherently too bulky for use in a portable tool. Other reciprocal mechanisms have inherently produced power or impact strokes which were too short for effective use in many applications, or too slow and weak for jobs requiring hammer blows of substantial force.

SUMMARY OF THE INVENTION

Basically, my invention comprises a portable power hammer for use in riveting, nailing, stoneworking, metalworking, woodworking, and the like. My power hammer is driven by an electric motor located within the housing of the hammer. The housing has a cylindrical extension wherein a piston is mounted in reciprocal relation. A connecting rod is pivotally connected at one end to the piston, and has a crankpin extending from the other end. The rotary motion of the motor shaft is transferred through gears to at least one drive gear. Drive means are associated with the drive gear for engaging the crankpin during a portion of each rotation of the drive gear to move the connected piston from an out dead center position to an in dead center position, and for releasing the crankpin to permit the piston to be returned to its out dead center position by a compression spring acting against the piston. The repetitive spring-powered return strokes of the piston are utilized, preferably by means of an impact element acted upon by the reciprocating piston, as hammer blows for the above-indicated uses. The shape of the impact surface of the impact element will vary depending upon its intended end use.

It is an object of the present invention to provide a portable, electrically driven power hammer which simply and efficiently converts rotary motion provided by an electric motor into a quick-return reciprocal motion for driving an impact element.

It is a further object of my invention to provide a compact, portable power hammer which is convertible to a variety of uses requiring repetitive power impacts.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a section view of a preferred embodiment of my power hammer, taken along section line 1–1 of FIG. 2, with the piston in its out dead center position.

FIG. 2 is a top view of my power hammer, with a portion of the housing broken out to show the interior thereof.

FIG. 3 is a partial side view taken along the same section line as FIG. 1, illustrating the piston in its in dead center position.

FIG. 4 is a side view of a drive gear of my power hammer.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring more particularly to the drawings, wherein like numerals refer to like parts throughout the several views, my power hammer is generally indicated by reference number **10** in FIGS. **1** and **2**. The housing means **11** is seen to consist of several housing sections. Motor housing section **12** comprises the base of the housing means **11** and is of conventional construction. A right gear housing section **13** and a left gear housing section **14** are bolted to the upper end of the motor housing section **12** to support and encase the gear means for transferring power from the motor **19**. The gear housing sections **13** and **14** are mirror images, and are maintained in accurate alignment by alignment pin **15***a* and **15***b*, shown in FIG. **1**, together with bolt connections to the motor housing **12** and other attached housings hereinafter described.

A trigger housing **16** is bolted to the rear side of the motor housing section **12** and right and left gear housing sections **13** and **14**. A piston housing section **17** extends from the front side of the right and left gear housing sections **13** and **14**, to provide a cylindrical extension of the housing means **11**. The piston housing section is designed for attachment of a tool chuck **18**.

An electric motor **19** and motor fan **20** are mounted in a conventional manner within the motor housing section **12**, which is ventilated to permit circulation of cooling air. An electrical switch **16***a* is mounted in the trigger housing **16** and connected with the motor **19** in a conventional manner to control operation of the motor. The lower end of the motor shaft **21** is supported by a lower motor bearing **22** mounted at the bottom of the motor housing section **12**. The upper end of the motor shaft **21** extends through the fan **20**, through upper motor bearing **23** and into the gear compartment **24** formed by right and left gear housing sections **13** and **14**.

A worm **25** is attached to the upper end of motor shaft **21** and engages worm gear **26** mounted on worm gear shaft **27**. The worm gear shaft **27** is supported at one end by a journal bearing **28** mounted in the left gear housing section **14**, and on the other end by an identical bearing (not shown) mounted in right gear housing section **13**. A pinion **29** is mounted on worm gear shaft **27** near journal bearing **28**, and meshes with transfer gear **30** mounted on transfer gear shaft **31**. Transfer gear shaft **31**, which is broken in FIG. **2** to show the underlying worm **25**, is supported at one end by normal bearing **32** mounted in left gear housing section **14**, and on the opposite end by an identical journal bearing (not shown) mounted in right gear housing section **13**. A pinion **33** is mounted on transfer gear shaft **31**, and meshes with left drive gear **34** mounted at one end of jackshaft **35**. The jackshaft **35** is supported at its other end by two sets of journal bearings **36** and **37**, to maintain the jackshaft **35** and mounted drive gear **34** in alignment while subject to external forces. All of the described gears are keyed to their respective shafts to positively transfer the rotary motion of the motor shaft **21** to the drive gear **34**.

The inside surface of left drive gear **34** is shown in FIG. **4**. It is seen that the inside surface of the gear has an arcuate slot **39**, with a front leading edge **40** and a trailing edge **41**. The arcuate slot **39** is of sufficient width and depth to receive the crankpin **42** in slidable relation, as shown in the broken out portion of drive gear **34** in FIG. **2**. The slot **39** is of sufficient length to permit the crankpin to slide in a 180° arc about the axis of the drive gear **34**.

Right drive gear **38**, partially shown in FIG. **2**, is identical to left drive gear **34**, is supported by the right gear housing section **13** in the same manner as the left drive gear, and is driven by a train of gears (not shown) identical to pinion **29**, transfer gear **30**, and pinion **33**. The unshown gears are located within the right side of the gear compartment **24**, on the same shafts as their identical counterparts described above.

The crankpin **42** extends from the crank end **44** of the connecting rod **43**. In the preferred embodiment shown, the crankpin extends from each side of the connecting rod to engage the arcuate slots in both the left and right drive gears **34** and **38**, in the manner described above. The connecting rod **43** is connected at its piston end **45** to a piston **46** by means of a connecting pin **45***a*. The piston **46** is mounted within the piston housing section **17** in reciprocal relation. A prelubricated sleeve bearing **17***a* is located between the piston **46** and the piston housing **17** to facilitate reciprocal movement of the piston **46**.

In FIGS. 1 and 2 the piston is shown in its out dead center position, which is its farthest position from the drive gears 34 and 38. The piston 46 is biased toward said out dead center position by the compression spring 48, which abuts the rear end of the piston. The opposite end of the compression spring abuts a flange 49 which is positioned between the piston housing section 17 and the right and left gear housing sections 13 and 14, and constitutes part of the housing means 11.

The piston 46 has an extension end 47 which extends beyond the end of the piston housing section 17 when the piston is in its out dead center position, as shown in FIG. 1, to engage an impact element 50 mounted within a substantially cylindrical tool chuck 18, which is bolted to the end of piston housing section 17. The impact element return spring 51 is compressed between the head 50a of the impact element and the internal shoulder 18a of the tool chuck 18 to bias the tool chuck toward the piston extension end 47. The travel of the impact element in the direction of the piston is limited by means in the form of an annular stop 52 which is engaged within the end of the piston housing section 17, as shown in FIG. 3. The opening in the annular stop 52 permits the piston extension end 47 to extend therethrough during the major portion of the piston cycle to strike and engage the impact element and transmit the hammer blow. The impact element 50 has a cylindrical body portion 50b of smaller diameter than the head portion 50a , which extends through the return spring 51, for a sufficient distance to project slightly from the chuck when the piston 46 is in the out dead center position shown in FIGS. 1 and 2. Prelubricated sleeve bearings 18b and 18c are located between the chuck 18 and the head portion 50a and body portion 50b, respectively, of the impact element to facilitate reciprocal movement thereof.

The shape of the impact surface 50c of the impact element will depend upon its intended use. The impact element 50 illustrated in FIGS. 1 and 2 is a riveting tool. The size of the indentation on the impact surface 50c of the riveting tool will depend upon the size of the rivets with which it is intended to be used. If it is desired to change tools, it is only necessary to remove the chuck 18 from the piston housing section 17, withdraw the impact element from the chuck, and insert another impact element tool for the particular use desired.

In operation, closing of the switch 16a in the trigger housing 16 causes rotation of the motor 19, which is transferred through the previously described gears to the drive gears 34 and 38. During each rotation of the drive gears 34 and 38, the trailing edges 41 of the arcuate slots 39 in the drive gears will engage the crankpin 42 when the piston 46 is in the out dead center position illustrated in FIG. 1. As the drive gears rotate, the crankpin will move in a circular path toward the rear of the hammer, and the connected piston will move from its out dead center position toward its in dead center position, illustrated in FIG. 3, to compress the spring 48. When the piston passes its in dead center position, the force of the spring against the piston and connected crankpin 42 will no longer be resisted by the trailing edges 41 of the drive gears. The compression spring will then abruptly move the piston 46 from its in dead center position to its out dead center position, to create a power stroke. The crankpin 42 will simultaneously slide from engagement with the trailing edges 41 of the arcuate slots 39 to the leading edges 40 of the slots. The piston 46 will remain in its out dead center position until the continued rotation of the drive gears 34 and 38 again brings the trailing edges of the arcuate slots into engagement with the crankpin, whereupon the cycle will be repeated.

It will be noted that the impact element 50, which is acted on by the piston 46 during the forward or power stroke of the piston, does not remain in abutment with the piston through all portions of its cycle. Rearward travel of the impact element 50 is limited by annular stop 52, as previously described. When the piston 46 reaches its in dead center position, it is spaced a substantial distance from the head 50a of the impact element 50, as shown in FIG. 3. As a result of such spacing, the piston head reaches a substantial velocity before striking the impact element head 50a, thereby producing a hammer blow against the impact element 50, which in turn transmits the force of the blow to the work abutting the exposed end of the chuck 18.

The frequency of the hammer blows will depend upon the speed of the motor and the ratios of the described gears. For a motor having a rated speed of 12,000 r.p.m., and a total velocity ratio between the motor 19 and the drive gears 34 and 38 of 32:1, there will be approximately 375 hammer blows per minute. It is preferable that a variable speed switch be employed, to permit the operator to control the speed of the hammer. It is, of course, obvious that the particular gear means employed for transmitting rotary motion of the motor 19 to the drive gears 34 and 38 may vary, depending upon the speed of the motor, and the number of hammer blows per minute desired. Accordingly, if a lower speed motor or a higher frequency of hammer blows is desired some of the gears employed in the preferred embodiment described above might be eliminated. It is also obvious that the piston may be driven by a single drive gear 34, and that the duplicate gears located in the right gear housing section 13 can be eliminated. However, use of a double set of drive gears as shown in the third embodiment provides a stronger drive mechanism which is more resistant to shock, and is suitable for heavier work.

It is understood that the drive means associated with the drive gears for engaging the releasing the crankpin is not limited to the particular arcuate slot described herein, but includes any equivalent means associated with the drive gear for engaging the crankpin during a portion of each rotation of the drive gear to move the connected piston from its out dead center position to its in dead center position and compress the spring 48, and then releasing the crankpin to permit the spring to abruptly return the piston to its out dead center position, thereby creating the required power stroke and resulting hammer blow.

It is further understood that my invention is not confined to the particular construction and arrangement of parts herein illustrated and described, but embraces all equivalent forms thereof.

I claim:

1. A power driven hammer comprising:

a. housing means having a cylindrical extension;

b. a piston mounted at least partially within said cylindrical extension for reciprocal motion therein between an out dead center position and an in dead center position and having an extension end which extends beyond the cylindrical extension of the housing means;

c. spring means engaged between said housing means and said piston, said spring means biasing said piston toward said out dead center position;

d. a connecting rod having a piston end pivotally connected to said piston and a crank end;

e. a crankpin extending from said connecting rod crank end;

f. gear means mounted in rotatable relation within said housing means;

g. drive means associated with said gear means for engaging said crankpin during a portion of each rotation of said gear means to move said connected piston from said out dead center position to said in dead center position thereby compressing said spring means, and then releasing said crankpin to permit said spring means to abruptly return said piston to its out dead center position to produce a hammer blow;

h. motor means mounted within said housing means and connected to said gear means in driving relation;

i. a chuck having an attached end and a free end is attached to the cylindrical extension of the housing means;

j. an impact element is positioned in slidable relation within said chuck in communication with said free end; and

k. a return spring extends between said impact element and said chuck to maintain said impact element in abutment with said piston during at least a portion of the reciprocal movement of said piston.

2. The power driven hammer described in claim 1 wherein stop means are located within the housing means to limit the travel of the impact element in the direction of the piston to provide a space between said piston and said impact element when said piston is in its in dead center position.

3. The power driven hammer described in claim 1 wherein at least one sleeve bearing is located within the chuck, and wherein the impact element is slidably engaged within said sleeve bearing.