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Consoli et al.

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[54] **ROTARY HAMMER POWER TOOL**

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[52] **U.S. Cl.**..... **173/48,** 173/109, 173/118, 173/170, 173/DIG. 3, 192/89 A, 192/67 R

[51] **Int. Cl.**..... **B25d 11/00**

[58] **Field of Search**..... 173/109–111, 173/116, 117, DIG. 3, 48; 192/89 A, 67 R; 74/22 R

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Primary Examiner—John E. Murtagh
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[57] **ABSTRACT**

A gear type drive train from the motor rotates a barrel, the latter having a drive formation in one end thereof configured to impart rotation to the shank of a tool element received therein. The gear train reciprocates a cylinder simultaneously with rotation of the barrel, which cylinder is reciprocally mounted within the barrel. A hammer is freely mounted within the cylinder and is pneumatically reciprocated for imparting hammering blows to a tappet mounted in the barrel between the hammer and the distal end of the tool element thereby in turn to impart hammering blows to the latter. A spring biases the tappet against the tool shank thereby to prevent flutter of the former. The rotary drive to the barrel may be selectively disconnected by a manually operated mechanism. A wall of the tool housing cooperates with the barrel to define an annular chamber for receiving a supply of grease; apertures are provided in the barrel and in the sleeve thereby permitting the grease to enter the barrel as well as the sleeve for lubricating the latter and the hammer.

3 Claims, 5 Drawing Figures

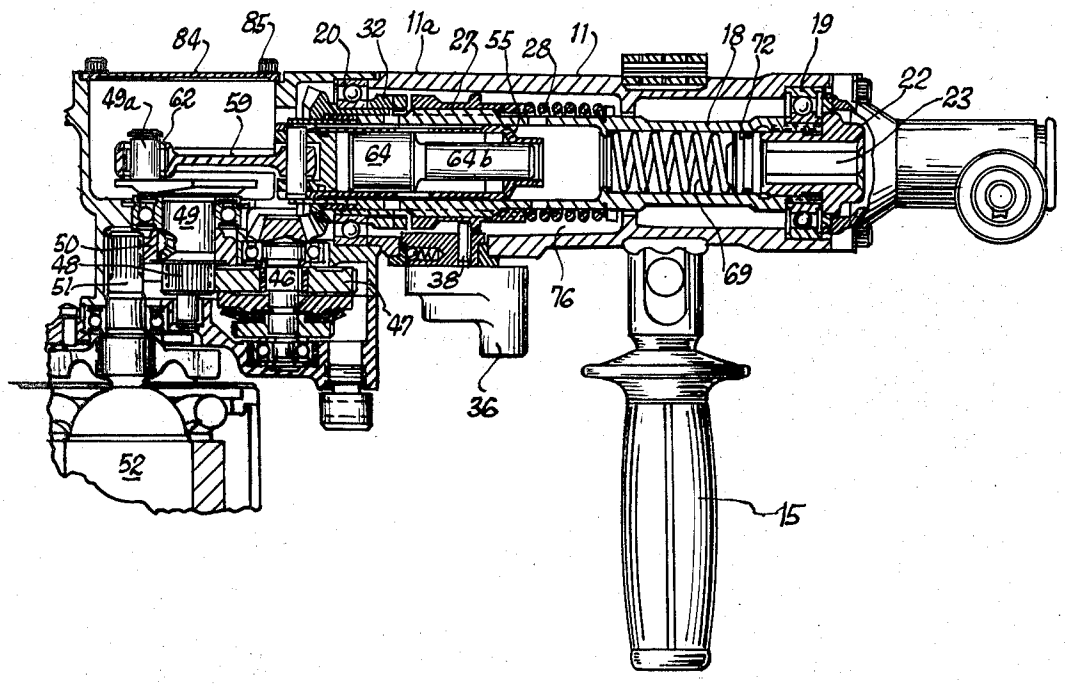
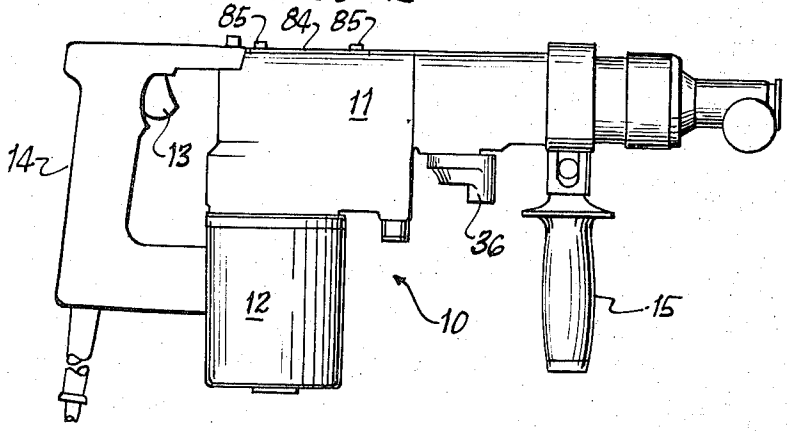


FIG. 1



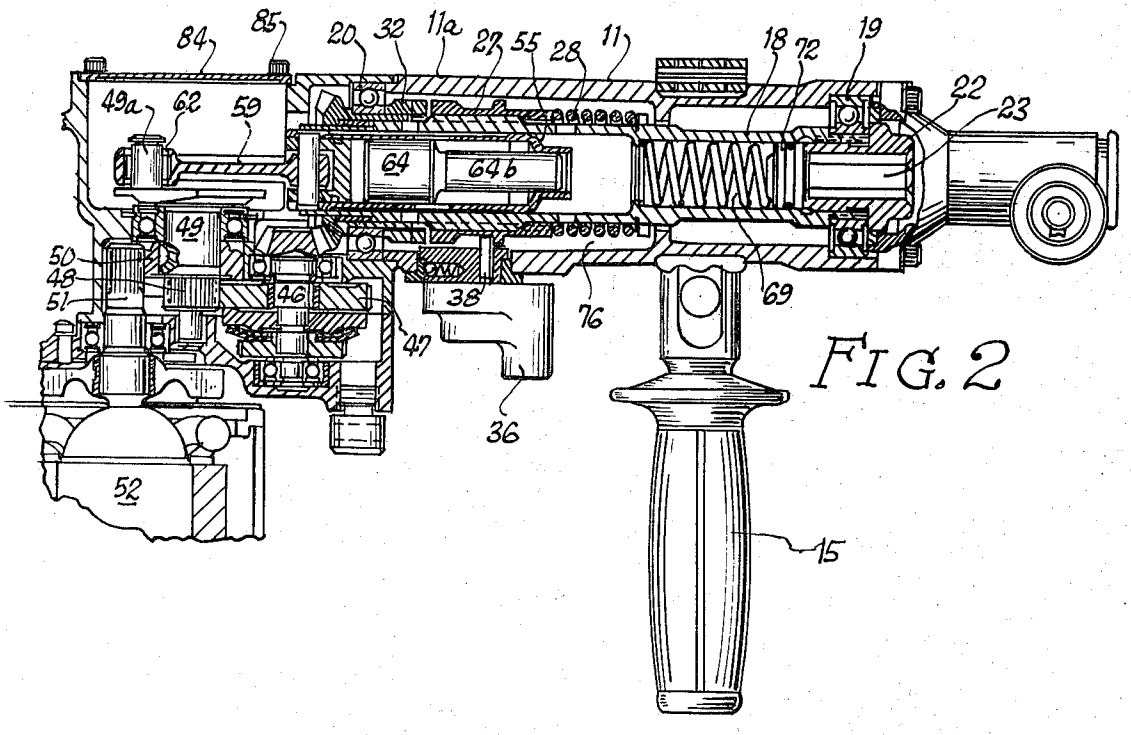


FIG. 2

FIG. 3

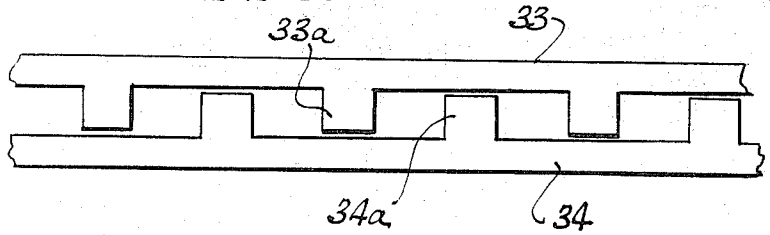


FIG. 4

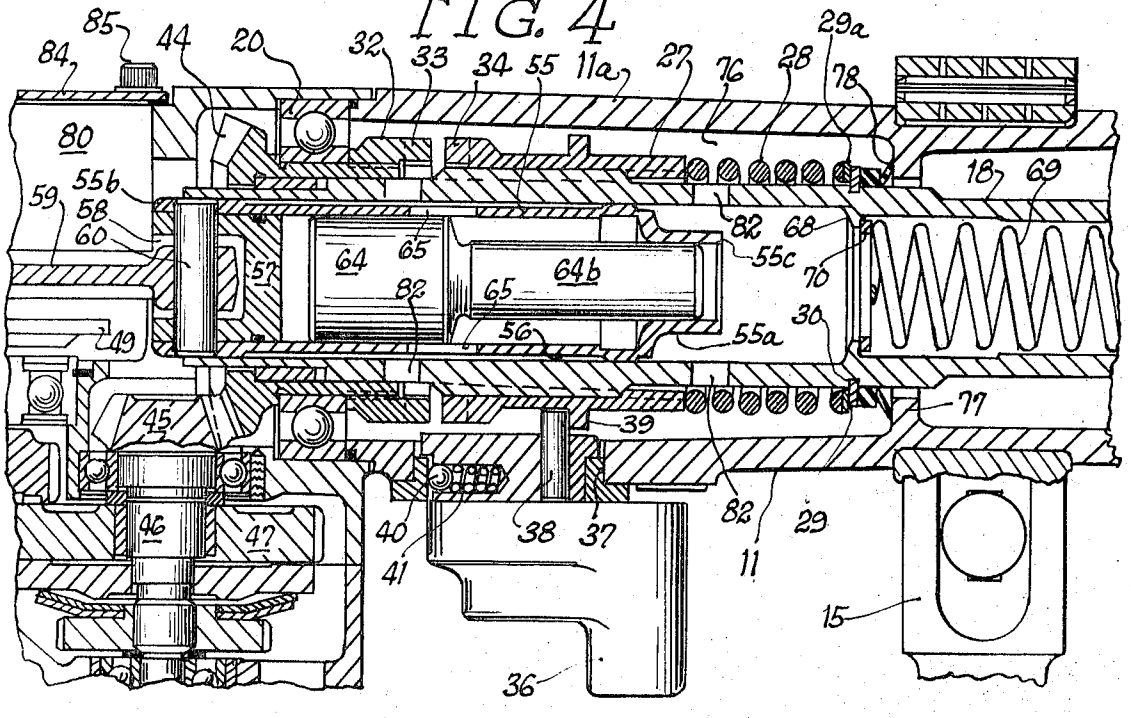

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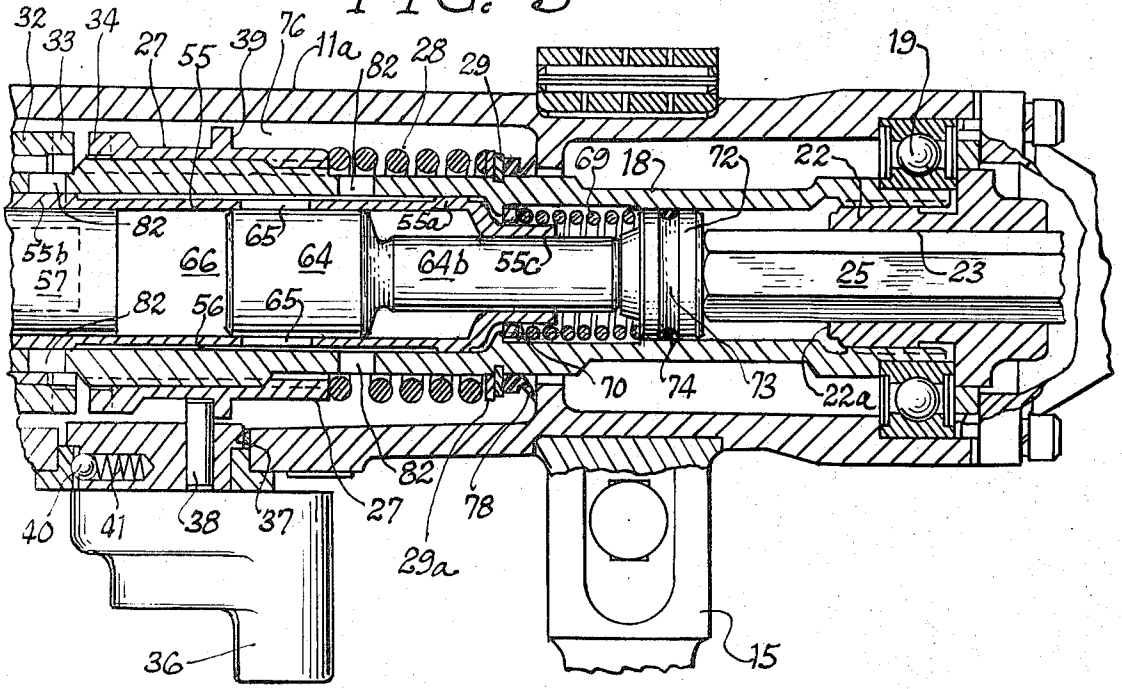
FIG. 5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ROTARY HAMMER POWER TOOL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of the invention relates to portable power tools. More particularly, the field of the present invention relates to so-called rotary hammer power tools, i.e., power tools which have the capability of imparting simultaneous rotation and axial hammering blows to a tool element for working on concrete, for example.

2. The Prior Art

Rotary hammer power tools of the type referred to are well known in the art. These tools are usually powered by an electric or pneumatic motor and include a rotary output or drive member having a hexagonal bore for receiving the correspondingly shaped shank of a tool element or adapter thereby to impart rotation to the latter. These tools include a hammering mechanism in the form of a reciprocal hammer arranged to strike the distal end of the shank of the tool element or adapter thereby to impart axial hammering blows to the latter simultaneously with the aforementioned rotation. Representative prior art tools are shown in Coates U.S. Pat. No. 1,191,948, Paule U.S. Pat. No. 3,456,740, Naslund et al. U.S. Pat. No. 3,114,423, McCloud U.S. Pat. No. 3,114,421 and Bassett et al. U.S. Pat. No. 3,270,821, the Naslund et al. McCloud and Bassett et al. patents being assigned to the assignee of the present invention.

In the use of power tools of the type under consideration, it is often required or at least desirable at certain times to impart a hammering action only to the tool element or adapter or to impart rotation only to the tool element. When using the power tools shown in some of the aforementioned patents, these different modes of operation are brought about by removing the element or adapter and replacing the same with a different element or adapter. In other words, these power tools are provided with plural different tool elements each specially configured to cooperate with the hammering and rotary components of the power tool for bringing about the desired mode of operation.

In some uses of these rotary hammer power tools, it is too time consuming for the operator to stop the tool, remove the tool element and insert a different tool element to achieve a different mode of operation. For example, when installing certain anchors in concrete structures, it is necessary first to hammer the anchor thereby to penetrate the concrete a short distance, and thereafter to impart simultaneous hammering and rotation to the anchor. Then, rotation only must be imparted to the anchor for removing the same in order to evacuate dust from the bore formed in the concrete. Finally, the anchor must be hammered in place without rotation. This operation could not be achieved economically and expeditiously if the operator were required to change the tool element each time to bring about the various modes of operation just described.

SUMMARY AND OBJECTS OF THE INVENTION

A primary object of the present invention is the provision of a rotary hammer power tool having new and improved means for imparting simultaneous rotation and hammering blows to a tool element or adapter.

Another object of the present invention is the provision of a power tool of the type described which includes a tappet disposed between the hammer and the distal end of the shank of the tool element thereby to transfer hammering blows from the hammer to the tool element, wherein a spring is provided for biasing the tappet against the tool element thereby to prevent flutter of the tappet.

Still another object of the present invention is the provision of such a power tool wherein the mass of the tappet is substantially less than the mass of the hammer.

Another object of the present invention is the provision of a power tool of the type under consideration which includes a manually operated rotary disconnect means whereby the operator of the tool may quickly and easily change the modes of operation from simultaneous hammering and rotation to hammering only and vice versa.

Still another object of the present invention is the provision of a power tool of the type described which includes a rotating barrel having a cylinder reciprocating therein, and a hammer pneumatically reciprocating in the cylinder, wherein a wall of the power tool cooperates with the barrel to define an annular chamber adapted to contain a supply of grease, the barrel and the cylinder being provided with apertures to permit the grease to enter the barrel as well as the cylinder for lubricating the latter and the hammer.

These and other objects and advantages of the present invention will become apparent from the following specification disclosing a preferred embodiment shown in the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a rotary hammer power tool embodying the present invention;

FIG. 2 is an enlarged fragmentary vertical section of the power tool;

FIG. 3 is a developed plan view of the clutch teeth forming part of the rotary disconnect of the barrel;

FIG. 4 is an enlarged vertical section of the power tool; and

FIG. 5 is an enlarged section similar to FIG. 4 showing the various parts in their position when a hammering blow is being imparted to the tool element via the spring biased tappet.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring particularly to FIG. 1, the portable rotary hammer power tool, generally designated **10**, includes a main housing **11** and a motor housing **12**. Although the power tool could be pneumatically operated, it will be understood that the power tool **10** includes a suitable electric motor vertically disposed within the housing **12** and arranged to be energized upon depressing the trigger **13** mounted by a handle **14**. An auxiliary handle **15** is mounted on the forward portion of the housing **11**.

A barrel **18** is rotatably mounted within the housing **11** by means of a forward ball bearing assembly **19** and a rearward ball bearing assembly **20**. A rotary drive formation **22** is fixedly mounted in the forward end of the barrel for rotation in unison therewith. This formation includes a through central bore **23** of hexagonal cross section for receiving the correspondingly shaped shank **25** of a tool element or adapter. Thus, rotation of the barrel **18** will impart corresponding rotation to the tool

element by reason of the hexagonal shape of the bore **23** and shank **25.**

A first sleeve **27** is mounted on the barrel **18** and is splined thereto such that the sleeve may slide axially relative to the barrel. By reason of this spline type of connection, rotation of the sleeve **27** will of course cause rotation of the barrel **18.** A coil spring **28** encircles the barrel and has one end thereof in abutting engagement with the forward end of the sleeve **27.** The other end of this spring engages a ring **29***a*, which ring abuts another ring **29,** the latter being received within an annular recess **30** formed in the outer surface of the barrel **18.** The spring **28** acts to urge the sleeve **27** rearwardly or inwardly (to the left as shown in the drawings) for purposes which will become apparent hereinbelow.

Another sleeve **32** is mounted on the barrel **18** for rotation with and relative to the barrel. As best noted in FIG. **4,** the sleeve **32** is interposed between the ball bearing assembly **20** and the barrel **18.** The sleeve **32** includes an integral formation of clutch teeth **33** at the forward end thereof, which teeth are arranged for engagement with an identical and opposite hand series of clutch teeth **34** formed on the inner end of the sleeve **27.**

Reference should now be had to FIG. **3** showing a developed view of these clutch teeth. The set of clutch teeth **33** on the sleeve **32** are in the form of plural teeth **33**a, the arcuate distance between adjacent teeth being substantially greater than the arcuate extent of each tooth. In like manner, the set of teeth **34** are in the form of individual teeth **34***a*, again, the open space between adjacent teeth having an arcuate extent substantially greater than the arcuate extent of each tooth. The provision of having these spaces between adjacent teeth substantially greater than the width of each tooth facilitates the engagement of the teeth when the sleeve **32** is rotating.

It will be apparent that the spring **28** urges the sleeve **27** inwardly so as to maintain the clutch teeth **33, 34** in meshing engagement. The sleeve **27** may be moved axially forwardly relative to the barrel **18** by means of a manually operated shift lever **36.** This lever is suitably rotatably mounted in a bore **37** formed in the housing **11** of the power tool, and carries a pin **38** eccentric with respect to the axis of rotation of the shift lever. The pin **38** engages a flange **39** integral with the sleeve **27.** It will be understood that rotation of the shift lever **36** in one direction will serve to move the sleeve forwardly against the force of the spring **28** to disengage the clutch teeth **33, 34.** Rotation of the shift lever **36** in the other direction will allow the spring **28** to return the sleeve **27** to its innermost position thereby bringing the clutch teeth **33, 34** into engagement. Preferably, the shift lever includes a detent ball **40** biased by a spring **41** thereby releasably to hold the shift lever **36** in its two positions corresponding to the engaged and disengaged positions of the sleeve **27.**

The sleeve **32** includes an integral formation of gear teeth **44** at one end thereof, these teeth being in meshing engagement with a gear **45** integral with a shaft **46.** The shaft **46** is driven by a gear **47,** this gear being in meshing engagement with teeth **48** integral with a crank shaft **49.** A gear **50** is keyed to the crank shaft **49,** which gear is driven by the shaft **51** of an electric motor **52** contained within the housing **12.**

A cylinder **55** is mounted within the barrel **18.** To this end, the cylinder **55** includes an annular formation **55***a* at its forward end and another annular formation **55***b* at its rearward end, these formations being in sliding engagement with the barrel and defining an annular space **56** between the barrel and the cylinder. A block **57** is fixedly mounted within the inner end of the cylinder **55.** This block has a recess **58** receiving one end of a connecting rod **59,** the latter being secured to the block **57** by means of a pin **60.** The connecting rod is secured to a pin **49***a* by means of a roller bearing assembly **62.** Of course, the pin **49***a* forms part of the crank shaft **49.** Thus, it will be apparent that the cylinder **55** will be reciprocated within the barrel **18** simultaneously with rotation of the sleeve **32.**

A cylindrical hammer **64** is mounted within the cylinder **55** for free reciprocal movement therein. The hammer **64** includes a reduced-in-diameter cylindrical formation **64***b*, the distal end of the latter being slidably received within a reduced-in-diameter portion **55***c* of the cylinder **55.** It will be understood that the hammer **64** is pneumatically actuated or reciprocated in response to reciprocation of the cylinder **55.** To this end, the cylinder **55** includes apertures **65** in the walls thereof for admitting a supply of air to the space **66** between the block **57** and the hammer **64.** This type of pneumatic hammering operation is well known in the art and therefore requires no further discussion herein.

The barrel **18** includes an integral, annular flange **68** intermediate the ends thereof. A coil spring **69** has one end thereof in abutting engagement with a washer **70,** the latter being held against the annular flange **68** by the spring **69.** The other end of this spring is engaged with a tappet **72** for urging the latter forwardly in the barrel **18.** The tappet **72** includes an exterior annular recess **73** which receives a ring **74.** It will be understood that the tappet **72** is mounted for reciprocal sliding movement within the barrel **18.**

When a tool element is not in place, as shown in FIG. **2,** the spring **69** urges the tappet **72** forwardly and into abutting engagement with an annular face **22***a* on the inner end of the drive formation **22.** When a tool element is mounted in the power tool, the distal end of the former engages the tappet **72** and moves the same inwardly against the force of the spring **69.** The hammer extension **64***b* strikes the tappet **72** (FIG. **5**) and thus hammering blows are imparted to the tool element when the distal end of the shank **25** is in abutting engagement with the tappet. In other words, opposite faces of the tappet are arranged to be engaged by the respective distal ends of the shank **25** and the hammer extension **64***b* thereby to transfer hammering blows from the hammer to the tool element. The spring **69** acts to prevent fluttering or unwanted axial reciprocal movement of the tappet during operation of the power tool. Also, this unwanted fluttering action is avoided by having the mass of the tappet **72** substantially less than the mass of the hammer **64.**

The housing **11** includes a wall portion **11***a* which cooperates with the barrel **18** to define an annular space or chamber **76;** the forwardmost extremity of this chamber is defined by an annular flange **77** integral with the housing **11.** A frusto-conical member **78** forms a seal between the flange **77** and the barrel **18.** This seal is held in place by the ring **29** on the barrel **18.**

The annular space **76** communicates with the crank case chamber **80** via the openings between the individual ball bearings of the ball bearing assembly **20.** It will be understood that the spaces **76** and **80** contain a supply of highly viscous lubricating composition, such as a suitable type of grease. The barrel **18** includes plural apertures **82** thereby to permit the grease to enter the barrel and lubricate the walls thereof. The grease passing through the apertures **82** will enter the annular space **56** between the cylinder **55** and the barrel **18** and will in turn enter the barrel through the openings **65.** Accordingly, the supply of grease from the space **76** will also lubricate the surfaces of the sleeve and hammer which engage each other.

The power tool **11** includes a plate **84** removably secured thereto as by means of fasteners **85.** The plate **84** may be removed from time to time to replenish the supply of grease. Under some conditions, it may be desirable to replace the ball bearing assembly **20** by a sintered type annular bearing which would not permit grease from the chamber **80** to pass to the annular chamber **76.** In the event such a bearing assembly is used for the sleeve **32,** suitable means, such as a cap or removable plate, will be provided in the housing wall **11***a* to replenish the supply of grease in the chamber **76** from time to time.

It will be apparent that the present invention provides a new and improved rotary hammer power tool for imparting simultaneous hammering and rotation to a tool element or adapter. If it is desired to convert from simultaneous hammering and rotation to hammering only, the shift lever **36** may be actuated to disengage the clutch teeth **33, 34.** The simultaneous hammering and rotation mode of operation may be quickly resumed, again by actuation of the shift lever **36;** this operation may be achieved even when the tool is in operation, i.e., with the sleeve **32** rotating. If it is desired to achieve rotation only, the tool may be withdrawn from the work which will result in the drive member **23** being moved axially relative to the shank **25** thereby allowing the tappet **72** to come to rest against the annular face **22***a*. The tappet will now be beyond the range of reciprocal movement of the hammer **64** and rotation only will be imparted to the tool element, provided the shift lever **36** is positioned for bringing about engagement of the clutch teeth **33, 34.**

We claim:

1. In a portable power tool of the type adapted to impart rotation and hammering blows simultaneously to an elongated tool element having a shank at one end thereof, the improvement comprising:

a. a barrel rotatably mounted in the housing of the power tool;

b. a rotary drive formation secured to said barrel at one end thereof for engaging the shank of a tool element when the latter is received in said one end of the barrel thereby to impart rotation to the tool element in response to rotation of the barrel;

c. motor means in said housing;

d. a cylinder coaxial with said barrel and slidably mounted in the latter adjacent the other end thereof for axial reciprocal movement therein;

e. a drive train connecting said cylinder with said motor such that the former is reciprocated upon operation of the latter;

f. a cylindrical hammer coaxially disposed within said barrel and mounted therein for pneumatic, reciprocal hammering movement in response to reciprocation of said cylinder, which hammer has a formation arranged to transmit hammering blows to the distal end of said shank;

g. a first sleeve coaxially mounted on said barrel for rotation with and relative to the barrel, said first sleeve including a first set of clutch teeth at one end thereof;

h. said drive train including gear means on the other end of said first sleeve connecting said first sleeve with said motor means for rotation of the former upon operation of the latter;

i. a second sleeve coaxially mounted on said barrel for reciprocal, axial sliding movement relative thereto, which second sleeve is connected to said barrel for imparting rotation thereto, said second sleeve mounting a second set of clutch teeth at one end thereof and arranged for engagement with said first clutch teeth; and

j. selector means mounted on the housing of the power tool and engaged with said second sleeve for reciprocating the latter axially thereby to engage and disengage said first and second clutch teeth for selective rotation of said barrel.

2. The improvement according to claim **1** wherein said first and second sets of clutch teeth are substantially identical and opposite hand versions of each other, each set of clutch teeth being in the form of a plurality of individual teeth arranged in circumferential spaced relation, the open space between adjacent teeth having an arcuate extent substantially greater than the arcuate extent of each tooth thereby to facilitate the engagement of said first and second sets of clutch teeth at times when said first cylindrical formation is rotating.

3. In a portable power tool of the type adapted to impart rotation and hammering blows simultaneously to an elongated tool element having a shank at one end thereof, the improvement comprising:

a. a barrel rotatably mounted in the housing of the power tool;

b. a rotary drive formation secured to the barrel at one end thereof for engaging the shank of a tool element when the latter is received at one end of the barrel thereby to impart rotation to the tool element in response to rotation of the barrel;

c. gear means connected to said barrel adjacent the other end thereof for rotation of the barrel in response to rotation of the gear means;

d. motor means in said housing including a drive train engaged with said gear means thereby to impart powered rotation thereto;

e. a cylinder coaxial with said barrel and slidably mounted in the latter adjacent said other end thereof for axial reciprocal movement therein;

f. said drive train including means engaged with said cylinder at one end thereof for reciprocating the same simultaneously with rotation of said gear means;

g. a cylindrical hammer coaxial with said cylinder and freely mounted therein for pneumatic, reciprocal hammering movement in response to reciprocation of said cylinder, which hammer has a coaxial extension arranged to project beyond and outwardly of the other end of said cylinder when the latter is in the forward portion of its stroke, which extension is arranged to transmit hammering blows

to the distal end of the shank of the tool element;

h. said housing of the power tool having wall means cooperating with said barrel to define an annular space therearound, which annular space has an axial extent substantially conterminous with the portion of said barrel in which said cylinder reciprocates;

i. seal means closing said annular space from the atomsphere and adapting said annular space to contain a supply of highly viscous lubricating composition, which seal means includes an annular seal engaging said wall means and said barrel to form a seal therebetween, said annular seal defining the forward limit of said annular space; and

j. said barrel and said cylinder each having apertures in the walls thereof thereby permitting the aforesaid lubricating composition to enter the barrel and said cylinder thereby to lubricate the cylinder and the hammer.

* * * * *