Nov. 30, 1954 W. A. PAPWORTH 2,695,522

POWER HAND TOOL

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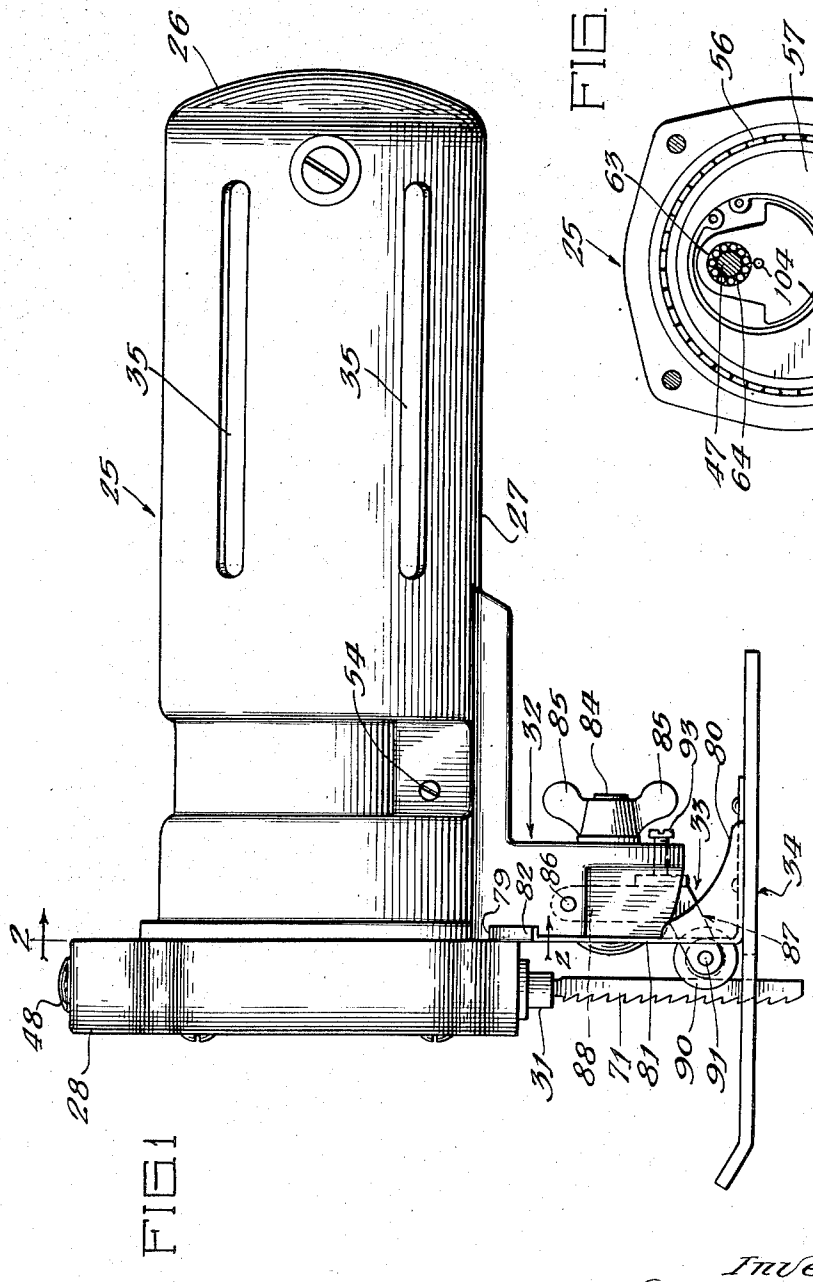


FIG 1

FIG 2

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FIG. 3

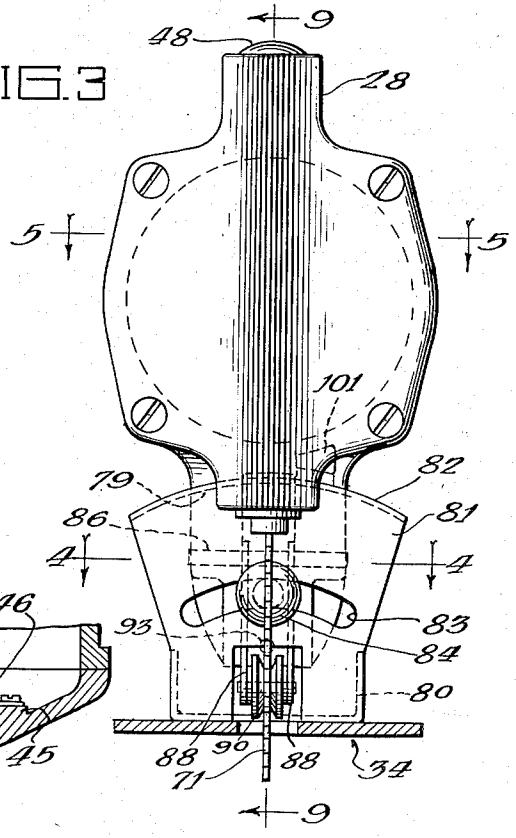


FIG. 5

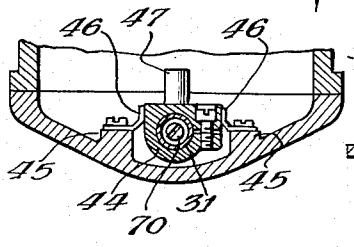


FIG. 6

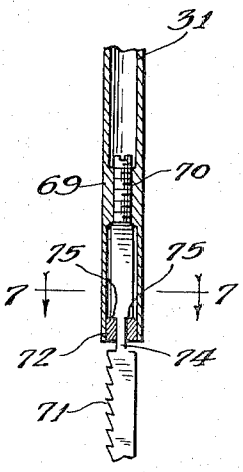
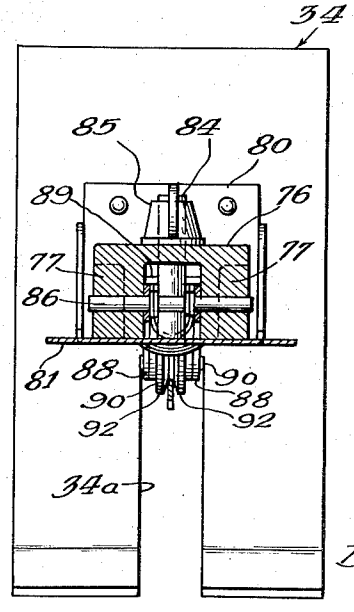


FIG. 4



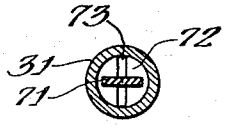
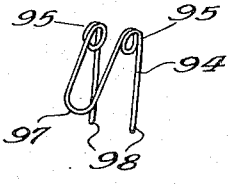


FIG. 7

FIG. 8



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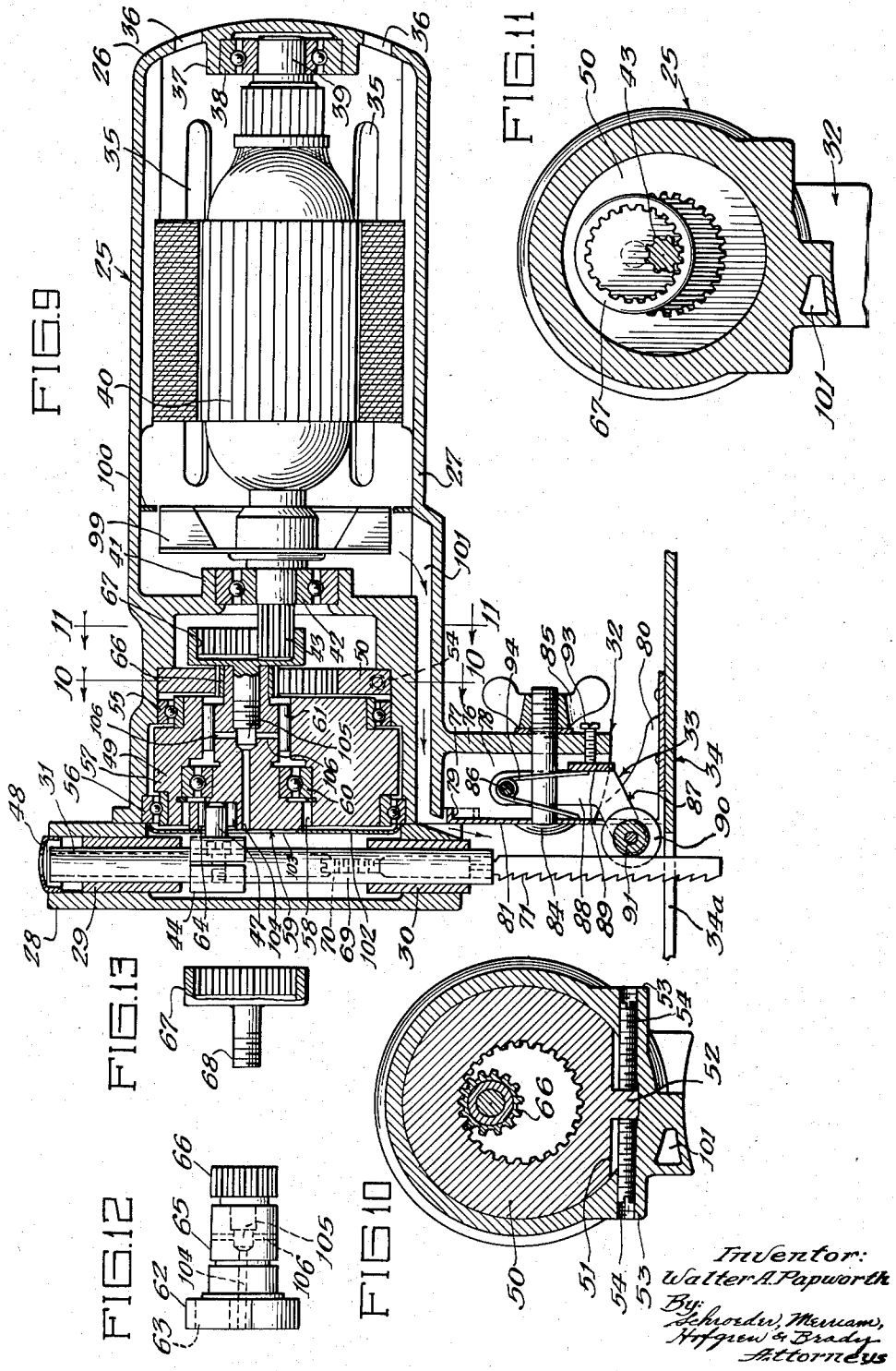


FIG. 9

FIG. 11

FIG. 13

FIG. 12

FIG. 10

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POWER HAND TOOL

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Application March 17, 1953, Serial No. 342,901

8 Claims. (Cl. 74—52)

This invention relates to a power hand tool having a reciprocable tool carrier for a tool such as a saw, file, knife, abrasive element or the like.

The principal object of the invention is to provide a compact hand tool of the above type.

Another object of the invention is to provide a hand tool which has a planetary drive for converting rotary to reciprocal motion, in which the motor and gear mechanism are mounted concentrically with the casing for the mechanism.

A further object is to drive direct from the motor pinion to the crankshaft which operates the tool, rather than from the motor pinion through the planetary gear carrier to the crankshaft. The most important result of this construction is to permit the speed reduction between the motor pinion and the reciprocable tool to be accomplished in two reducing stages, rather than having a single stage of reduction which is partly counteracted by a speed up stage. This reduces pressure on the gear teeth and bearings.

Another object of the invention is to so proportion the parts that conventional ball and roller bearing assemblies may be used throughout the mechanism.

Another object of the invention is to provide adjustment of the driving mechanism from outside the casing to take up backlash.

Another object is to provide a compact assembly for an adjustable support roller for a reciprocable tool, and a rockable foot plate which permits the tool to be used for bevel sawing.

Another object of the invention is to provide a simple system for circulating lubricant to the transmission parts.

The invention is illustrated in a preferred embodiment in the accompanying drawings in which:

Fig. 1 is a side elevation of a hand tool embodying the invention;

Fig. 2 is a fragmentary section taken as indicated along the line 2—2 of Fig. 1;

Fig. 3 is a front elevation of the tool;

Fig. 4 is a section taken as indicated along the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary section taken as indicated along the line 5—5 of Fig. 3;

Fig. 6 is a fragmentary vertical central section of the tool holder, showing the method of mounting a tool in the tool holder;

Fig. 7 is a section taken as indicated along the line 7—7 of Fig. 6;

Fig. 8 is a perspective view of a spring which is used on the guide roller support;

Fig. 9 is a section taken as indicated along the line 9—9 of Fig. 3;

Fig. 10 is a section taken as indicated along the line 10—10 of Fig. 9;

Fig. 11 is a section taken as indicated along the line 11—11 of Fig. 9;

Fig. 12 is an elevational view of the crank shaft for the planetary transmission; and

Fig. 13 is a side elevation, partly in section, of the planetary internal gear which is screwed to the face of the planetary pinion at the right hand end of the crank shaft.

Referring to the drawings in greater detail, and referring first to Fig. 1, the tool is provided with a casing, indicated generally at 25, which has an end wall 26 and a side wall 27 forming a cylindrical bore. Screwed onto a flange at the front of the casing 25 is a removable

cover plate 28 which contains bushings 29 and 30 (see Fig. 9) which provide a guideway for a reciprocable, hollow tool plunger 31. An integral depending support portion 32 is positioned adjacent the front of the casing 25 to receive tool guide and foot plate assemblies, indicated generally at 33 and 34, respectively, which will be described in more detail later. The cylindrical side wall 27 of the casing body is provided with ventilation slots 35, and the closed end of the casing body is provided with ventilation slots 36.

Referring now to Fig. 9, at the rear of the casing, on the closed end wall 26 thereof, is an integral boss 37 which supports a ball bearing assembly 38 for one end of the shaft 39 of an electric motor 40 which is supported in the casing with the shaft 39 coaxial with the bore of the casing. Forward of the motor 40 is a support annulus 41 for a bearing assembly 42 which supports the front of the motor shaft 39, the motor shaft being provided at its outer end with a pinion 43 so that it provides a drive shaft for the tool.

The hollow tool plunger 31 in the cover plate 28 has mounted upon it, in front of the open end of the casing 25, a crank block 44, which, as best seen in Fig. 5, is split at one side so that it may be clamped onto the tool plunger with a screw. A pair of crank block guides 45 are screwed to bosses 46 on the inside of the cover plate 28 to give lateral support to the crank block 44. At the rear of the crank block 44 is a crank pin 47. A friction cap 48 closes the top of the guideway for the tool plunger 31.

The driving connection between the drive pinion and the crank block 44 on the tool holder is provided by a planetary transmission, indicated generally at 49. The various parts of the planetary transmission are so proportioned and arranged as to convert the rotary motion of the drive pinion 43 to the desired reciprocating motion of the tool plunger 31, in a well known manner. Immediately forward of the drive pinion 43, and coaxial therewith, is a ring gear 50 which has a straight lower margin 51 having at its center a lug 52 (see Fig. 10). At the line of the ring gear 50 the casing 25 is provided with bosses 53 which are bored and tapped to receive opposed adjusting screws 54 which bear upon opposite sides of the lug 52 to secure the ring gear to the casing. Thus, the ring gear 50 may be rotatably adjusted through a small angle from outside the casing by changing the setting of the two adjusting screws 54. This permits adjustment of the direction of the drive to provide optimum alignment of the power thrust with the line of movement of the tool plunger 31.

Forward of the ring gear 50 are two spaced sets of ball bearings 55 and 56 which support a planetary gear carrier 57 which is coaxial with the drive shaft 39 and drive pinion 43. Eccentrically disposed in the planetary gear carrier 57 is a cavity 58 to receive a planetary crank shaft 59 which is journalled in the cavity 58 on ball bearings 60 and needle bearings 61. As best seen in Figs. 12 and 13, the planetary crank shaft includes a crank disc 62 which is recessed at 63 to receive a crank journal bearing 64 and which is cut away to provide a counterbalance, a shaft portion 65 which has at its rear end an integral planetary pinion 66, and a planetary internal gear 67 which has a threaded stud 68 by which it may be screwed into the face of the planetary pinion 66. As seen in Fig. 9, the planetary crank shaft 59 is assembled with the planetary pinion 66 engaging the ring gear 50 and the planetary internal gear 67 engaging the drive pinion 43. The crank pin 47 on the crank block 44 of the tool plunger 31 is journalled in the crank journal bearing 64 at the front of the crank shaft. Thus, the drive is from the motor 40 through the drive pinion 43 and the planetary internal gear 67 direct to the planetary crank shaft 59 and thus through the crank pin 47 to the tool plunger 31. The engagement of the planetary pinion 66 with the ring gear 50, and the eccentric positioning of the planetary crank shaft 59 in the planetary gear carrier 57 imparts the necessary movement to the planetary gear carrier.

As best seen in Figs. 6 and 7, the hollow tool plunger 31 has adjacent its lower end a threaded plug 69 to receive a set screw 70 which bears upon the upper end

of the tank of a saw blade or other tool **71** supported in the tool plunger. A bushing **72** in the bottom of the tool plunger is provided with a slot **73** which is disposed transversely to the plane of the saw blade **71**, and the blade is provided with a narrow neck portion **74** affording shoulders **75** which rest upon the top of the bushing **72** when the saw blade is secured in the tool holder. To remove the saw blade it is merely necessary to lossen the screw **70** and rotate the blade 90° so that it may drop downwardly through the slot **73** in the bushing.

As best seen in Figs. 1, 3, 4 and 9, the depending support portion **32** on the casing **25** has a transversely extending pack plate **76** and a pair of spaced forwardly extending wing members **77** affording a cavity **78**. The wing members **77** have in their front upper margins arcuate recesses **79** which are segments of an arc of a circle.

The foot plate **34** has a longitudinal slot **34***a* to accommodate the saw blade **71**. The foot plate **34** is carried on a support bracket **80** which has an upstanding front plate **81** the upper end portion of which is bent rearwardly to provide an arcuate flange **82** which engages the arcuate recesses **79** so that the foot plate **34** may be rocked to permit bevel cuts to be made with the saw blade **71**. The front plate **81** of the bracket **80** is also provided with an arcuate slot **83** which is concentric with the arcuate flange **82** and aligned with an aperture in the back plate **76** of the support portion **32** so that a locking bolt **84** may extend through the arcuate slot **83** and the aperture in the back plate to receive a wing nut **85** by means of which the foot plate **34** may be firmly secured at any desired angle with respect to the vertical line of the saw blade **71**.

The tool guide means **33** includes a pin **86** which extends across the cavity **78** and is supported in apertures in the wing portions **77**. Pivotally mounted on the pin **86** is rocker means **87** which has a pair of spaced rocker arms **88** tied together by a cross bar **89**. A guide roller **90** is journalled on a pin **91** which is supported in the arms **88**, said roller **90** having a pair of spaced circumferential ribs **92** affording an annular recess to receive the rear of the saw blade **71**. A set screw **93** is supported in a threaded hole in the support portion **32** and bears against the cross bar **89** of the rocker means **87** so that the position of the guide roller **90** may be adjusted with respect to the saw blade **71**. A hairpin-like spring **94** (see Fig. 8) has spaced eyes **95** by means of which it is supported on the pin **86**, and the spring has its forward end **97** bearing against the front plate **81** of the bracket **80** for the foot plate **34**, and its spaced rear arms **98** bearing against the cross bar **89** of the rocker means **87** so that the guide roller **90** is ordinarily urged away from the saw blade **71**.

As best seen in Fig. 9, positioned on the motor shaft **39** immediately ahead of the motor **40** is a finned fan member **99**, and inside the side wall **27** of the casing adjacent the rear edge of the fan member **99** is an annular baffle **100** to increase the volume of air which may be moved by the fan. The bottom of the casing side wall **27** is provided with a bore **101** which extends from an area adjacent the lower edge of the fan **99** to a position directly in the rear of the bottom bushing **30** in the cover plate **28**, so that air drawn by the fan through the slots **35** and **36** in the casing to cool the motor **40** is discharged through the passage **101** and directed downwardly at the area of the foot plate **34** immediately adjacent the saw blade **71** in order to blow sawdust away from the front of the saw blade so that a person using the tool may see any guide line which he is attempting to follow on the work he is doing.

As best seen in Figs. 9 and 12, lubrication of the bearings **60** and **61** for the planetary crank shaft **59** is obtained by means of a thin oil retaining plate **102** which is snapped into the cover plate **28** to cover the open front of the casing **25** immediately adjacent the crank disc **62**, the oil retaining plate having a vertical slot **103** to accommodate the crank pin **47**. An axial passage **104** is formed in the crank shaft **59**, extending from the front of the crank disc **62**, adjacent the oil retaining plate **102**, to a counterbore **105** in the bottom of the threaded aperture which receives the threaded stud **68** on the planetary internal gear **67**. From the counterbore **105** transverse bores **106** extend outwardly to the bearings **61**. As the crank shaft is rotated the eccentric motion of the crank disc **62** picks up oil from the oil

retaining plate **102** and forces it through the passage **104** and the transverse bores **106** to lubricate the bearings **60** and **61**.

The operation of the unit is believed to be clear from the foregoing description. The tool is provided with an electric cord and plug cap (not shown) and a switch (not shown) by means of which the motor **40** may be started and stopped. For straight cuts with a saw blade the foot plate **34** is set perpendicular to the line of the blade, or by adjusting the position of the mounting bracket **80** with respect to the depending support portion **32** of the casing the tool may be set to make a bevel cut. The rocker member **87** is adjusted by means of the set screw **93** until the guide roller **90** is lightly in contact with the back of the saw blade.

The drive from the pinion **43** to the tool plunger **31** effects the speed reduction from the pinion to the tool plunger in two stages, both of which are reduction stages. This result is achieved by reason of the fact that the drive pinion **43** drives the medium speed crank shaft **59** directly, and rotation of the slow speed planetary gear carrier **57** is produced by reason of the eccentric positioning of the crank shaft in the carrier and the driving connection between the small planetary pinion **66** and the large ring gear **50**. In units of this type heretofore made, to applicant's knowledge, the drive has always been from the drive pinion to the carrier, which in turn drives the crank shaft. With the latter arrangement there is necessarily a single step down in speed which is partially counteracted by a step up in speed.

The entire unit except the motor and drive shaft may be disassembled merely by removing the cover plate **28**, which carries the tool plunger **31** and oil retaining plate **102**. Loosening of the securing and adjusting screws **54** for the ring gear **50** then permits the entire planetary gear assembly **49** to be drawn forwardly out of the casing **25**.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations are to be understood therefrom, as some modifications will be obvious to those skilled in the art.

I claim:

1. A power hand tool comprising: a casing; a motor at one end of said casing, said motor having a drive shaft; a gear on said drive shaft; linear guide means at the end of the casing opposite said motor; a tool plunger slidably mounted in said guide means; and planetary gear means in said casing for reciprocating said tool plunger, said means including a planetary gear carrier journalled in said casing, a planetary crank shaft eccentrically journalled in said carrier, and gear means on said crank shaft meshing directly with said gear on the motor drive shaft, whereby rotational movement is imparted to the carrier through the crank shaft.

2. A power hand tool comprising: a casing; a motor at one end of said casing, said motor having a drive shaft; a gear on said drive shaft; linear guide means at the end of the casing opposite said motor; a tool plunger slidably mounted in said guide means; and planetary gear means in said casing for reciprocating said tool plunger, said means including a ring gear secured to the casing, a planetary gear carrier journalled in said casing coaxial with said drive shaft; a planetary crank shaft eccentrically journalled in said carrier, and gear means on said crank shaft meshing directly with said ring gear and with said gear on the motor drive shaft, whereby rotational movement is imparted to the carrier through the crank shaft.

3. A power hand tool comprising: a casing having a cylindrical bore; a motor in said casing having a drive shaft coaxial with the bore of the casing; a pinion on said drive shaft; a ring gear secured to the casing coaxial with the drive shaft; a planetary gear carrier journalled in said casing coaxial with the drive shaft; a planetary crank shaft eccentrically journalled in said carrier, said crank shaft having a planetary internal gear meshing with said pinion and a planetary pinion meshing with said ring gear; linear guide means at one end of the casing adjacent said crank shaft; a tool plunger slidably mounted in said guide means; and a crank pin making a driving, pivotal connection between said tool plunger and the crank shaft.

4. A power hand tool comprising: a casing having a cylindrical bore and an open front end; a motor mounted adjacent the rear of said casing and having a drive

shaft coaxial with the bore of the casing; a pinion on the drive shaft; a ring gear deteachably secured to said casing adjacent to and coaxial with said motor drive shaft; a planetary gear carrier mounted on two sets of ball bearings between said ring gear and the open end of the casing, said carrier being coaxial with the motor drive shaft; a planetary crank shaft journalled in bearings eccentrically mounted in said carrier, said crank shaft having a planetary pinion engaging said ring gear and a planetary internal gear engaging said pinion; a cover plate detachably secured to the open end of the casing, said cover plate having an internal flange which retains the front set of ball bearings for the planetary gear carrier; linear guide means in said cover plate; a tool plunger slidably mounted in said guide means; and a crank pin making a driving pivotal connection between said crank shaft and said tool plunger to reciprocate the latter.

5. A power hand tool comprising: a casing; a motor mounted in said casing, said motor having a drive shaft; a pinion on said drive shaft; a ring gear coaxial with the drive shaft, means securing said ring gear to the casing; a planetary gear carrier journalled in said casing coaxial with said drive shaft; a planetary crank shaft eccentrically journalled in said carrier to receive a crank pin, said crank shaft having a planetary internal gear meshing with said pinion and a planetary pinion meshing with said ring gear; linear guide means at the front of said casing; a tool plunger slidably

mounted in said guide means; and a crank pin making a driving pivotal connection between said planetary crank shaft and said tool plunger to reciprocate the latter.

6. The device of claim 5 in which the ring gear is secured to the casing by screw means extending to the outside of the casing, said screw means abutting against the gear so that it may be rotatably adjusted to change the line of the crank shaft in the casing.

7. The device of claim 5 in which the crank shaft and planetary pinion are unitary and extend through the planetary gear carrier and ring gear, and the planetary internal gear overlies a portion of the ring gear and is screwed to the face of said planetary pinion.

8. The device of claim 5 in which the crank shaft is provided with a crank journal bearing to receive a crank pin on the tool plunger.

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