

Jan. 6, 1959

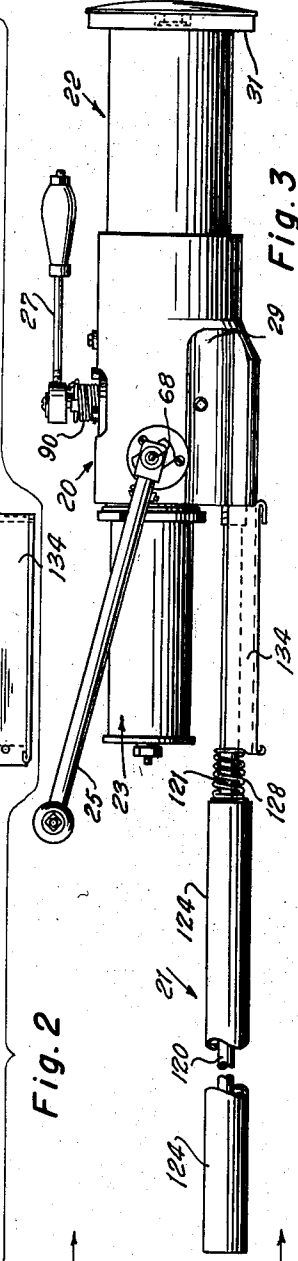
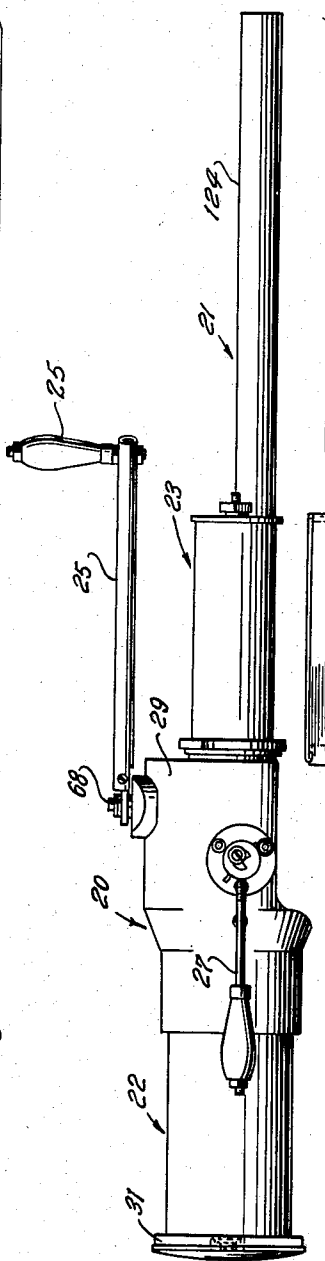
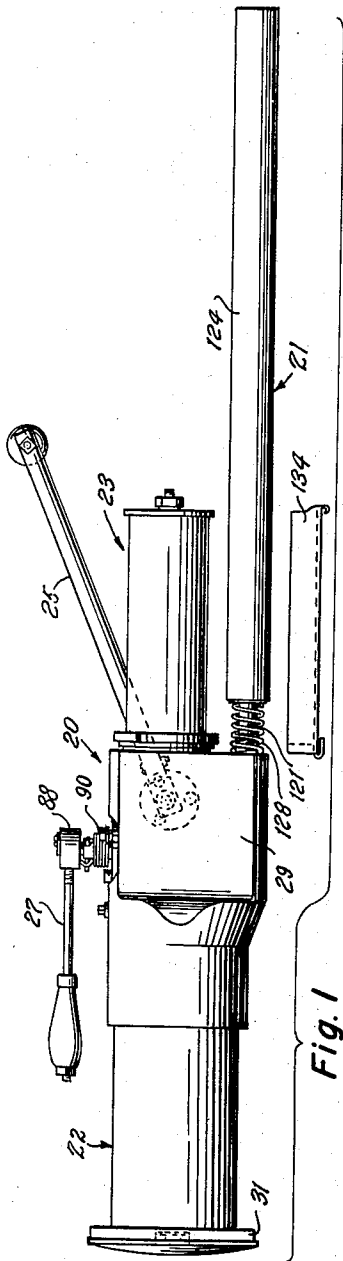
E. L. HALEY

2,867,086

PORTABLE PRESSURE FLUID POWER DEVICES

Filed Dec. 20, 1954

3 Sheets-Sheet 1



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PORTABLE PRESSURE FLUID POWER DEVICES

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3 Sheets-Sheet 2

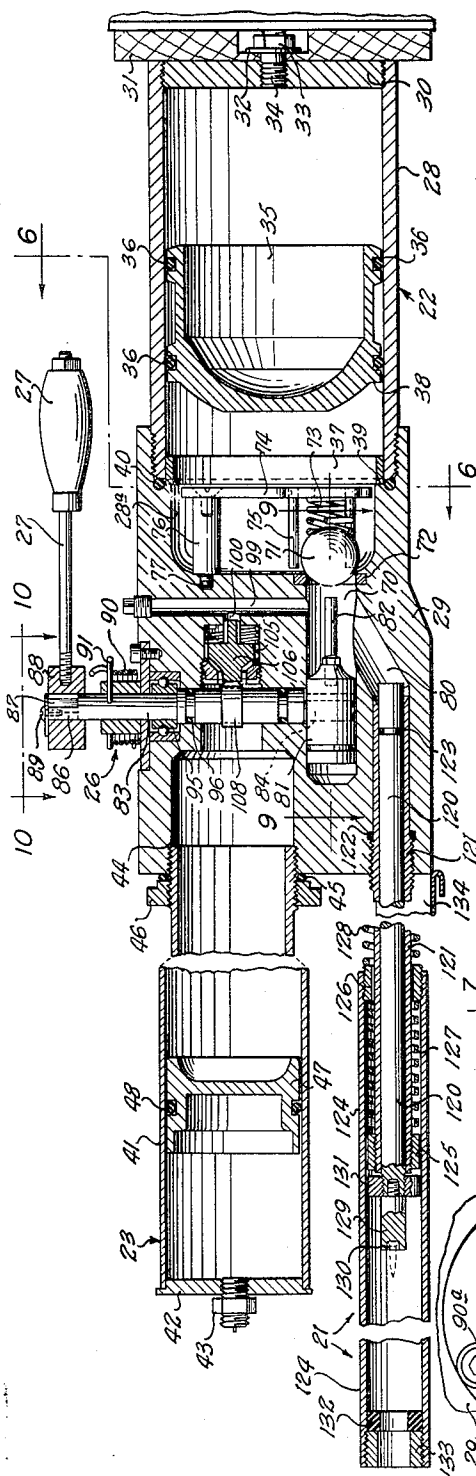


Fig. 5

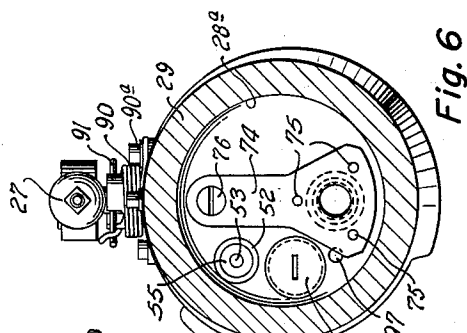


Fig. 6

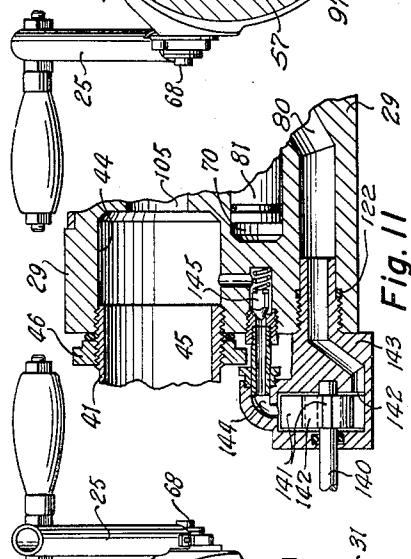


Fig. 11

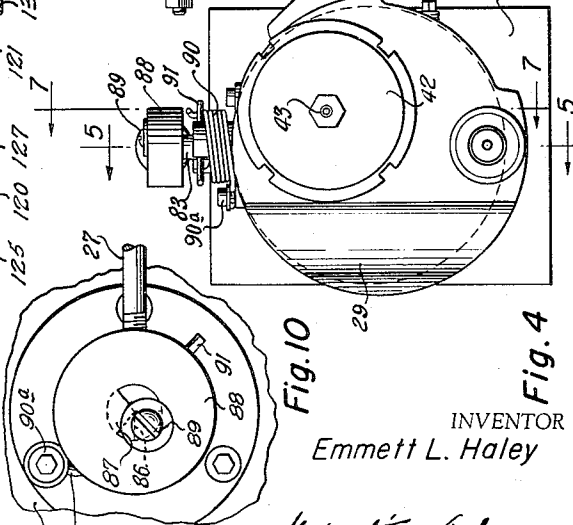


Fig. 10

Fig. 4

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PORTABLE PRESSURE FLUID POWER DEVICES

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3 Sheets-Sheet 3

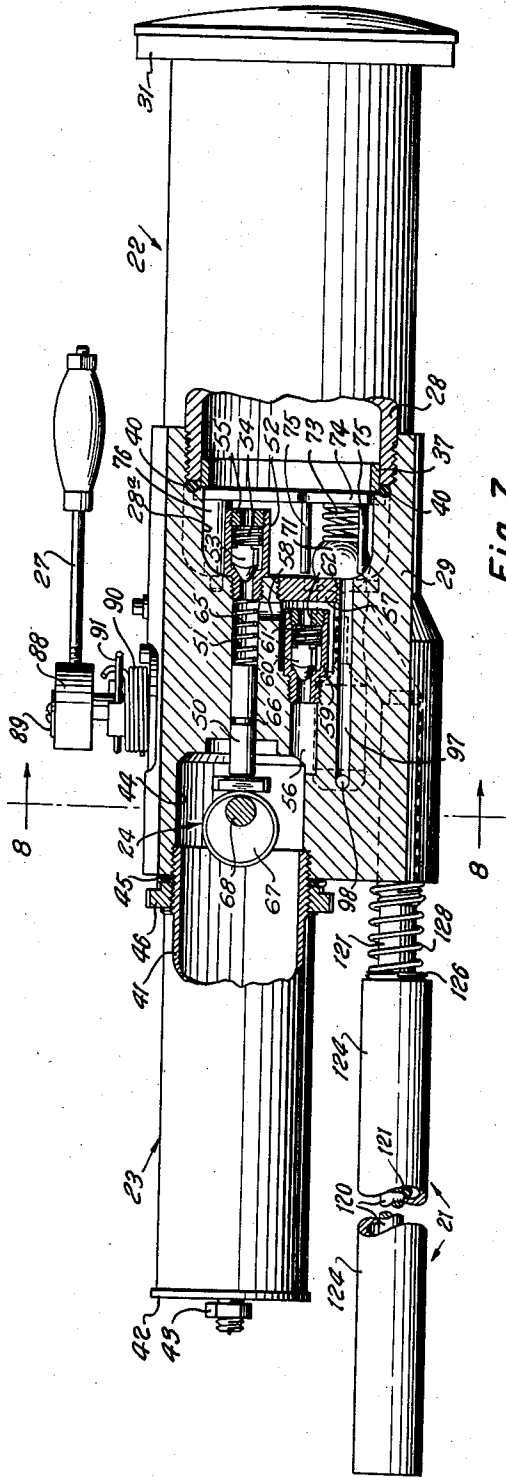


Fig. 7

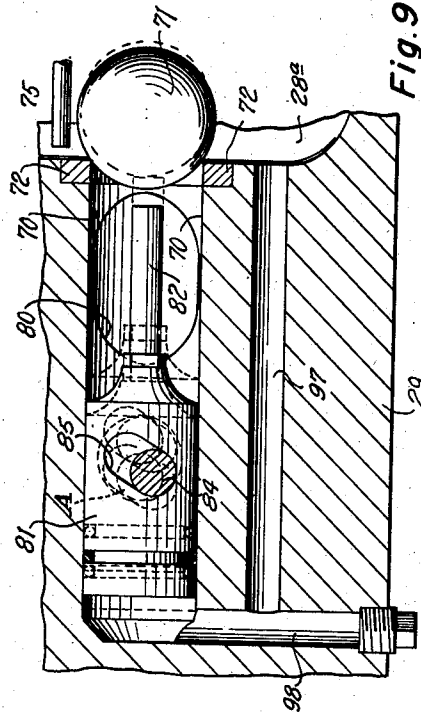


Fig. 9

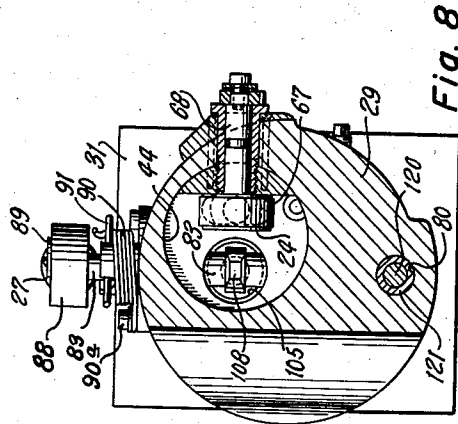


Fig. 8

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PORTABLE PRESSURE FLUID POWER DEVICES

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Application December 20, 1954, Serial No. 476,277

9 Claims. (Cl. 60—51)

This invention relates to a portable pressure fluid power device for hand tools.

One object of the invention is to provide a new and improved portable pressure fluid power device for operating hand tools.

Another object is to provide a portable power device for operating hand tools which is self-contained in that when it is in operation it is not required that the same be connected to sources of power such as compressed air or electrical current.

Still another object of this invention is to provide a power device, of the type described, which is portable and easily operable by a single operator.

A further object of the invention is to provide a portable power device of the type having a reservoir of stored energy and means for releasing said energy in controlled amounts to drive a desired hand tool.

A still further object is to provide a new and improved power device having a power reservoir in which a compressible fluid, such as air, is maintained under pressure, which is employed to impart movement to a relatively non-compressible driving fluid which in turn actuates a suitable driving means such as a piston or hammer of a hand tool.

Another object is to provide a new and improved hand tool having a self-contained power device.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of devices constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

Figure 1 is a side elevation of the power device showing it employed to power hammer-like hand tools.

Figure 2 is a top view of the power device,

Figure 3 is a view in elevation of the opposite side of the power device of Figure 1, showing an adapter or spacer in place for holding the hammer sleeve in driving position,

Figure 4 is an end view of the power device taken on the line 4—4 of Figure 3,

Figure 5 is a sectional view taken along the line 5—5 of Figure 4,

Figure 6 is a sectional view taken on the line 6—6 of Figure 5,

Figure 7 is a view partly in elevation and partly in section taken on the line 7—7 of Figure 4,

Figure 8 is a sectional view taken on line 8—8 of Figure 7,

Figure 9 is a sectional view taken on line 9—9 of Figure 5,

Figure 10 is a view taken on line 10—10 of Figure 5, and

Figure 11 is a fragmentary sectional view of a portion of the power device showing a tool attached thereto and adapted to be employed to impart rotary movement to a power shaft of a hand tool.

Referring now particularly to Figures 1 through 10 of the drawings, the numeral 20 designates a power

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device used to provide the energy for operating a hammer-like or nail driving hand tool 21. The power device includes an accumulator or power reservoir 22 which is adapted to contain a compressible fluid under high pressure, a drive fluid reservoir 23, a pump device 24 operable by the handle 25 for transferring the drive fluid from the fluid reservoir to the power reservoir, and a trigger mechanism 26 operable by the trigger handle 27 for permitting drive fluid under high pressure to flow in controlled amounts substantially instantaneously from the power reservoir to the hammer, impact or nail driving hand tool 21 to effect operation of the latter.

The accumulator or power reservoir 22 includes a cylinder 28 having one end threaded into a bore 28a in the rear end of a main connector body 29 while its other end is closed by a disk 30 threaded thereto and soldered or otherwise secured in place to prevent leakage. A body engaging member or rest 31 is connected to the disk 30 by means of washer 32 and a nut 33 disposed on the outer end of a valve stem 34 threaded into a central aperture through the disk and having a valve therein. Air is admitted into the cylinder 28 through the valve stem, but is prevented from escaping therefrom by the valve in said stem, and the air so admitted is preferably highly compressed or under super-atmospheric pressure.

A cup-shaped piston 35 is slidably disposed in the cylinder 28 and is provided with a pair of seal rings 36 which seal between the piston and the cylinder. Movement of the piston 35 in one direction is limited by a stop ring 37 which is adapted to engage the annular stop shoulder 38 at the inner end of the piston. The stop ring abuts an internal annular shoulder 39 in the bore 28a of the connector body 29. A fluid tight seal is effected between the cylinder 28 and the connector body by a seal ring 40 disposed adjacent the stop ring 37 and compressed between the cylinder and the connector body.

A non-compressible drive fluid such as hydraulic oil is pumped from the drive fluid reservoir 23 through suitable passageways in the connector body into the cylinder 28 to move the piston 35 toward the disk 30. The drive fluid reservoir includes a cylinder 41 having one end closed by a cap or closure 42 provided with an air valve 43 admitting air into said cylinder but preventing escape of air therefrom. The other end of the reservoir cylinder is threaded into a bore 44 in the front end of the connector body.

A seal ring 45 disposed about the cylinder 41 is compressed between the connector body and a seal nut 46 threaded on the cylinder to effect a fluid tight seal between the cylinder and the connector body. A movable plunger or piston 47 is disposed in the reservoir cylinder 41 and is provided with an external seal ring 48 for sealing between the cylinder and the plunger. The plunger moves in the cylinder 41 as the drive fluid is admitted into the bore 44 in the front end of the connector body, as will be hereinafter more fully explained. The air trapped and compressed between the movable plunger and the cap 42 serves to bias the plunger toward the bore 44 of the body to maintain such bore always full of drive fluid. Thus fluid is always present in the bore 44 regardless of the amount of drive fluid actually contained in the cylinder 41.

The drive fluid is moved from the cylinder 41 of the fluid reservoir 23 to the cylinder 28 of the power reservoir by the pump device 24. As shown in Figure 7, the pump device includes a piston 50 slidably mounted in a passageway 51 formed in the connector body 29 and extending between the rear bore 28a and the front bore 44 of the connector body. The end of the passageway

adjacent the rear bore 28a has a valve cage 52 threaded therein which holds a valve 53 biased toward closed position by a spring 54 confined between the valve and an apertured plug 55 threaded in the outer end of the cage.

A second passageway 56 formed in the connector body extends between the front bore 44 and the rear bore 28a but is closed from direct communication with the bore 28a by a plug 57. An interconnecting passageway 58 connects the passageway 51, at a point between the piston 50 and the valve 53, with the passageway 56 adjacent the plug 57 and between said plug and a second valve cage 59 threadedly mounted substantially midway of the passageway 56. The valve cage holds a valve 60 which is biased toward closed position by a spring 61 confined in the valve cage by an apertured plug 62.

The pump piston 50 is biased toward the left (Figure 7) by a spring 65 disposed in the passageway 51 and bearing at its opposite ends against the piston and the valve cage 52. An O-ring 66 disposed in a peripheral groove provided in the pump piston seals between the piston and the wall of the passageway 51. The pump piston is moved to the right (Figure 7) against the resistance of the spring 65 by a cam 67 mounted on the inner end of a shaft 68, the shaft 68 being rotated by means of the handle 25 secured to the outer end of said shaft. The shaft extends into the bore 44 of the connector body through a suitable bore in said connector body. The handle 25 is rather long so that the mechanical advantage between the handle and the pump piston is relatively great.

Let it be assumed now that the passageway 51 is full of the non-compressible drive fluid and that the handle 25 is moved to rotate the shaft 68. As the shaft is rotated the cam 67 thereon engages and moves the pump piston 50 inwardly in the passageway 51 against the resistance of the spring 65, causing the drive fluid in the passageway 51 to move the valve 53 toward open position to permit the drive fluid to flow through the valve cage 52 and the plug 55 into the bore 28a of the connector body. Pressure of the drive fluid in the passageway 51 acting through the interconnecting passageway 58 upon the valve 60 tends to move that valve toward closed position. As the rotation of the shaft 68 is continued, the cam 67 is moved out of engagement with the pump piston 50 and permits the piston to be moved in the opposite direction by the spring 65. As the pump piston moves to the left (Figure 7) a suction or pressure reduction is created in the passageway 51 so that fluid tends to flow from the drive fluid reservoir 23 through the passageway 56 past the valve 60, which moves to open position, and through the interconnecting passageway 58 to the passageway 51 to again fill such passageway with drive fluid. The valve 53 is, of course, closed during this movement of the drive fluid. In this manner, each rotation of the handle 25 will cause a certain amount of drive fluid to be pumped from the drive fluid reservoir to the power reservoir. Due to the large mechanical advantage of the whole pumping system, the drive fluid may be moved into the power reservoir against extremely high pressures maintained therein by the compressed air or fluid behind the piston 35.

The connector body 29 is also provided with a drive fluid passageway 70 which communicates with the rear bore 28a and which is normally held closed by a ball valve 71. The ball valve 71 bears against a ring seat 72 of suitable material inserted or positioned in an annular recess surrounding the rear end of the passageway 70. The ball valve is biased toward closed position by a spring 73 confined between the ball and a bracket 74 carrying three guide posts 75 spaced uniformly around the ball and the sides of the spring. The bracket 74 is held in place in the bore 28a of the connector body by a post 76 whose reduced end 77 is threaded in a suitable socket in the connector body.

Drive fluid may flow from the bore 28a to the passageway 70 when the ball valve is open, and such drive fluid is transmitted to a hand tool, such as the nail driver 21, through an offset or angular passageway 80 which communicates at its rear end with the passageway 70. It is desirable that the drive fluid flow in single shots or controlled amounts to the hand tool so that it is necessary that the ball valve 71 be opened very quickly by the trigger mechanism 26 to permit quick full flow of drive fluid past said valve. The trigger mechanism includes a trigger piston 81 slidably mounted in the bore or passageway 70 and having a forward prong or extension 82 for contacting the ball valve and opening it. The trigger piston is reciprocated by a rotatable trigger shaft 83 having the handle 27 secured to its outer end. The inner end of the trigger shaft 83 is provided with an off-set projection 84 which slidably engages in a slot 85 extending diagonally with respect to the longitudinal axis of the trigger piston, as clearly shown in Figure 9.

The outer end of the trigger shaft 83 is also provided with an offset projection 86 which extends outwardly through the central bore of a ring 88 rotatably mounted on the outer end of the trigger shaft. A stop member or boss 87 projects inwardly into the bore of the ring 88 and provides a pair of spaced radially disposed stop shoulders which are adapted to engage the offset projection 86 of the trigger shaft to limit rotative movement of the ring on the shaft but to provide a lost-motion connection between the ring and shaft, whereby the shaft may rotate independently on the ring through a predetermined arc of movement. The ring 88 is held in place on the shaft by a washer and screw 89 threaded into the outer end of the offset projection 86 of the trigger shaft, and the handle 27 is screwed into a lateral threaded opening in the ring 88. The trigger shaft is biased toward clockwise rotation (Figure 10) by a torsion spring 90 disposed about the shaft and having one of its ends secured to the connector body by a screw 90a and its other end bearing against a pin 91 projecting laterally outwardly from the trigger shaft.

The trigger shaft is rotatably mounted in the connector body 29 by means of a ball bearing assembly 95 to insure easy rotation of said shaft. O-rings 96 seal between the connector body and the trigger shaft to prevent leakage of drive fluid outwardly along the trigger shaft.

The ball valve 71 is ordinarily subject to very high pressure, of the order of 2000 pounds per square inch or more, so that the pressure differential on opposite sides of the ball valve is very great, and in order to open the ball valve a correspondingly great force must be applied to the ball by means of the trigger piston 81 and the prong 82 carried thereby for engaging the ball valve. To accomplish this, as shown in Figure 9, drive fluid is conducted from the power cylinder 22 by way of a longitudinal passageway 97 and a transverse passageway 98 to the rear end of the passageway 70 behind the trigger piston where such drive fluid acts against the rear end of the piston to bias the same toward the ball valve. The cross-sectional area of the trigger piston under such pressure is preferably substantially equal to that of the seat opening of the ball valve seat, whereby a sufficient force will be exerted by the piston, in the manner to be hereinafter more fully described, to provide for readily and quickly opening the ball valve when the trigger device is operated.

The drive fluid which flows from the bore 28a into the passageway 70 each time the ball valve 71 is opened is returned to the drive fluid storage reservoir 23 by way of a transverse passageway 99 which communicates at one end with the passageway 70 between the valve seat 22 and the trigger piston 81. The passageway 99 has a lateral opening 100 intermediate its ends which leads into a valve chamber 105 having a normally closed spring loaded valve 106 mounted therein. The valve 106 is opened by a cam 108 on the trigger shaft 83

after the drive fluid has been admitted through the passageway 70 and the angular passageway 80 to operate the nail driver 21 or other tool connected with said angular passageway. When the trigger shaft is turned to open the valve 106, the inner offset projection 84 on said shaft first moves the trigger piston 81 away from the ball valve 71 to permit such ball valve to close to prevent escape of drive fluid from the power reservoir. Upon continued rotation of the trigger shaft, the valve 106 is opened and the drive fluid in the passageway 70 and in the angular passageway 80 is permitted to drain or escape therefrom through the passageway 99 and the valve chamber 105 past the valve 106 into the front bore 44 of the body and the reservoir cylinder 41, where it is under a substantially reduced pressure, of the order of less than one hundred pounds per square inch.

The power device is placed in condition for use by introducing a compressible fluid, such as air, under high pressure, into the power reservoir 22 through the one-way valve 34. The compressed air, of course, moves the piston 35 leftward (Figure 5) until its motion is stopped by the stop ring 37, and the air is introduced into the power reservoir until the pressure within the reservoir reaches a desired value, say one thousand pounds per square inch, whereupon the valve 34 is disconnected from the source of compressed air and the power device may be carried to the place of use. The handle 25 is then rotated to pump drive fluid from the drive fluid reservoir 23 to the rear bore 28a and thus into the power reservoir cylinder, causing the power piston 35 to move toward the right (Figure 5), further compressing the air in the power reservoir until the desired operating pressure is attained, such movement of the power piston being possible because the air is compressible. At this time the fluid pressure within the power reservoir may be two thousand pounds per square inch or more, and the energy stored therein is available to operate a hand tool such as the nail driver 21. If desired, a suitable relief valve may be mounted in the wall of the body 29 and providing communication between the rear bore 28a of the body and the front bore 44, whereby the pressure of the drive fluid in the power reservoir may not exceed a predetermined value for which the relief valve is set.

The hand tool may be a hammer or impact tool of any desired type, such as the nail driver 21, which includes a piston or hammer 120 slidably mounted in a barrel 121 which extends into the passageway 80 and is threadedly held in place therein, the O-ring 122 preventing leakage of drive fluid therebetween. The hammer 120 is also provided with an O-ring 123 mounted in an external annular groove near its inner or rear end to seal between the barrel and the hammer. A sleeve 124 telescopes over the outer ends of the barrel 121 and the hammer. The outer end of the barrel is provided with a stop ring 125 threaded exteriorly thereon and the inner end of the sleeve is provided with a stop ring 126 threaded interiorly thereinto, and a spring 127 is confined on the barrel and in the sleeve between said stop rings. A second spring 128 is mounted exteriorly of the barrel and is confined thereon between the stop ring 126 of the sleeve and the front end of the connector body.

The outer end of the hammer has an adapter or hammer face 129 threadedly connected thereto, said face having at its outer end a recess 130 in which the head of a nail to be driven by the hammer may be held. An external stop ring 131 is also threadedly connected to the outer end of the hammer and is adapted to engage a resilient stop ring 132, secured in the bore of the sleeve 124 by a retainer ring 133, to limit outward movement of the hammer and to cushion the shock of the hammer blow at the end of its stroke.

The length of the stroke of the hammer is determined by the distance the hammer moves in the barrel, and the

rear or inner end of the hammer may be moved to any desired position longitudinally of the barrel by sliding the sleeve 124 rearwardly toward the body. The resilient ring 132 in said sleeve engages the stop ring 131 on the hammer and, as the sleeve is moved rearwardly on the barrel, the hammer is moved rearwardly in the barrel to the position giving the desired length of stroke of the hammer. The sleeve is then moved outwardly or forwardly on the barrel until the ring 126 engages and compresses the spring 127, and the spring 128 is moved outwardly on the barrel and confined between the inner end of the sleeve 124 and a spacer member 134 which is inserted between the inner end of the spring 128 and the front of the body 29 to hold the sleeve in the extended "cocked" or firing position.

In use, the outer end of the sleeve 124 of the nail driver is rested against the surface into which a nail is to be driven while the hammer is in the inward or "cocked" position providing for a stroke of the desired length. The trigger mechanism of the power device is then actuated to open the ball valve substantially instantaneously. Drive fluid moving with great velocity is thus suddenly admitted, under full pressure of the compressed air in the power cylinder, to the passageway 80 to act on the hammer, quickly moving and accelerating the same longitudinally forwardly through the barrel and sleeve until the stop ring on the front end of the hammer hits the shock absorber 132. During this movement of the hammer, it drives the nail into the surface. The spring 127 tends to absorb the shock of firing and stopping the movement of the hammer through the barrel and against the outer end of the sleeve. The spring 128 tends to maintain the outer end of the sleeve in contact with the work or material into which the nail is being driven, even though the body 29 is moved rearwardly slightly upon firing the device.

After a nail has been driven, the power device is reset or "recocked" by rotating the trigger handle 27 counterclockwise (Figure 10) causing the boss 37 in the bore of the ring 83 to engage the outer offset projection 86 of the trigger shaft 83 and thus to rotate the trigger shaft. As the trigger shaft is rotated, the inner offset projection 84 disposed in the slot 85 of the trigger piston moves the trigger piston to the left (Figure 5) until such offset portion moves to or past the dead center position A (Figure 9). At this point, the trigger piston is locked against movement toward the ball valve. As the trigger piston is moved away from the ball valve 71, that ball valve moves to closed position, and just before the end of the cocking rotative movement of the trigger shaft, the cam 108 engages and unseats the valve 106. The spacer 134 is then removed from a position holding the sleeve extended and the sleeve is moved rearwardly to move the hammer rearwardly in the barrel to the desired set position for the length of stroke giving the desired force of blow to the nail or other object being hammered. The length of the stroke of the hammer determines the force of the blow struck thereby. During this resetting movement of the hammer or piston, the trigger handle is held locked in cocked position and the valve 106 is held open by the cam 108, which permits the hammer to move the quantity of drive fluid used in the last operation back into the storage reservoir. The passageways 70, 80 and 99, however, remain filled with drive fluid, but under reduced pressure.

When it is desired to "fire" or operate the hand tool, after the hand tool or hammer has been set in proper "cocked" or operative firing position in the manner already described, the trigger handle is swung in the opposite direction, clockwise in Figure 10, rotating the trigger shaft and moving the cam 108 away from the valve 106 and permitting said valve to close. Such rotation of the trigger shaft also moves the offset projection 84 engaged in the slot 85 in the trigger piston past the dead center position, whereupon the pressure of the drive fluid acting

on the trigger piston and the force exerted by the spring 90 moves the piston very quickly to the right (Figure 9) toward the ball valve, causing the prong or extension 82 on the front end of the trigger piston to strike the ball valve 71 a sharp blow, opening the ball valve instantaneously due to the momentum of the trigger piston. The lost-motion connection between the outer end of the trigger shaft and the trigger handle permits such movement of the trigger shaft without corresponding movement of the handle 27 of the trigger mechanism. The spring 90 acts to hold the ball valve unseated. During the short interval of time after the ball valve 71 is opened, drive fluid moves with great velocity through the passageways 70 and 80 to the barrel of the hand tool for operating the latter. However, only a relatively small quantity of such drive fluid leaves the power reservoir, such quantity being determined by the volume represented by the product of the cross-sectional area of the hammer times the length of the stroke of the hammer. This is true because the passageways are already full of drive fluid, as has been hereinbefore explained; and since the valve 106 is closed, the full force of the drive fluid is applied to the hammer.

After the "firing" or operation of the hand tool, the trigger handle is again rotated in a counter-clockwise manner (Figure 10) to close the ball valve 71 and open the valve 106 to allow the expended drive fluid to move back to the storage reservoir 23 as the hand tool is reset, in the manner already described.

This sequence of operations is repeated each time the hand tool is operated, with the compressed air moving the power piston to the left (Figure 5) a short distance each time the ball valve is opened and a quantity of drive fluid escapes from the power reservoir. The hand tool may thus be operated a great number of times until the pressure therein has been reduced to the lowest desirable value, or until leftward movement of the power piston is arrested by the stop ring 37. The pumping must be then repeated to again pump the drive fluid from the storage reservoir to the power reservoir and recharge the tool.

It is believed readily apparent that any suitable type of movable power or pressure member other than the power piston 35 may be used, if desired; for example, a bellows arrangement, a diaphragm arrangement or the like, for suitably separating the air and drive fluid and for applying the pressure of the compressible fluid to the drive fluid. It is also believed manifest that the ball valve 71 may be operated directly by a cam on the trigger shaft, if desired, rather than by using the trigger piston and its associated parts.

It is also believed apparent that drive fluid might be transferred at intervals to the power cylinder from a central reservoir containing a large quantity of such fluid under high pressure, thus eliminating the need for the pump mechanism. In such event, the storage reservoir would be drained of excess drive fluid at the same time that the power cylinder is filled. This would reduce weight of the tool, and require only infrequent trips to the reservoir to refill the power cylinder.

It will thus be seen that the power device is self-contained and can be carried about from place to place without dragging compressed air lines and electrical supply lines, since the power reservoir acts as an accumulator or storage for energy. It will also be apparent that due to the high pressures available, a large amount of energy may be stored and employed to operate a hand tool a great number of times before the pumping or recharging operation must be repeated.

Referring now to Figure 11, a different hand tool is shown which includes a shaft 140 which must be rotated and is therefore provided with suitable slidable impeller vanes 141 which are movably mounted in radially disposed slots formed in an impeller body 142 mounted in a chamber in a housing 143 threaded to the connector body 29, so that the drive fluid flows into the housing

chamber and exerts a force on the impeller vanes to cause the shaft to rotate. The outlet 144 from the impeller chamber is connected to the storage reservoir through a check valve 145 so that if a hand tool of this type is to be employed, the valve 106 of Figure 5 may be omitted, the drive fluid merely flowing directly through the impeller mechanism to the storage chamber.

It will now be apparent that a new and improved power device for hand tools has been provided for operating hand tools of either the impact or hammer type or the rotary type, and which includes a power reservoir having a power member or power piston 35 movable in one direction by a biasing force such as may be provided by a compressible fluid, a drive fluid reservoir 23, a pumping mechanism for moving the drive fluid from the fluid reservoir to the power reservoir to move the power member in the opposite direction against the biasing force, valve means 71 for permitting the drive fluid to escape from the power reservoir to a hand tool, and a trigger mechanism 26 for opening the valve means instantaneously to apply the full pressure of the drive fluid to the operation of the hand tool.

It will also be apparent that a relatively great amount of energy may be stored in the power reservoir and may be utilized to operate a hand tool many times before the pumping or refilling operation must be repeated.

It will also be apparent that the trigger mechanism is easy to operate since the full fluid pressure of the drive fluid is applied to the trigger piston 87 to actuate the piston rapidly and open the ball valve instantaneously, and that the lost-motion connection between the trigger handle 27 and the trigger shaft 83 permits free movement of the trigger piston opening the valve without requiring corresponding movement of the trigger handle, thus preventing transmission of shock to the user when the power device is operated or fired. The device may obviously be used with any other suitable type of hand tool such as shears, clamps, jacks, or the like, requiring the application of a large force over a relatively short distance.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A power device comprising: a power fluid reservoir; a second reservoir for a compressible fluid; a power member in said second reservoir urged in one direction by said compressible fluid; means for transferring power fluid from said power fluid reservoir to said second reservoir to move said power member in the opposite direction against the force exerted by said compressible fluid; and means for releasing power fluid from said second reservoir to an element to be actuated by said power fluid to operate said element; said means for releasing power fluid including a valve member, means resiliently urging said valve member toward closed position, and a quick-acting trigger mechanism including a trigger piston actuated by the power fluid and movable into contact with said valve member to move said valve member to open position, means engageable with said trigger piston for holding said trigger piston against movement into engagement with said valve member and releasable to permit said trigger piston to move into contact with said valve member, passage means providing fluid communication between the space between said trigger piston and said valve member and said power fluid reservoir, valve means controlling flow through said passage means, said means engageable with said trigger piston for holding said trigger piston against movement also having means engageable with said valve member controlling flow through said passage means for actuating said valve means and operable to permit said valve

means to close before said trigger piston is released for movement into contact with said valve member.

2. A power device comprising: a power fluid reservoir; a second reservoir for a compressible fluid; a power member in said second reservoir urged in one direction by said compressible fluid; means for transferring power fluid from said power fluid reservoir to said second reservoir to move said power member in the opposite direction against the force exerted by said compressible fluid; a conductor from said reservoir to an element to be operated by said power fluid; valve means for releasing power fluid from said reservoir to said conductor to an element to be operated to operate said element; a trigger mechanism for opening said valve means; said valve means for releasing power fluid including a valve member, and means resiliently urging said valve member toward closed position; said trigger mechanism including a trigger piston movable into contact with said valve member to move said valve member to open position; said conductor from said valve to said element to be operated communicating between said valve and said trigger piston; said power device having means for equalizing the pressure differential between said valve member and said trigger piston to minimize the force needed to move the trigger piston and open said valve member.

3. A power device comprising: a power fluid reservoir; a second reservoir for a compressible fluid; a power member in said second reservoir urged in one direction by said compressible fluid; means for transferring power fluid from said power fluid reservoir to said second reservoir to move said power member in the opposite direction against the force exerted by said compressible fluid; valve means for releasing power fluid from said second reservoir to an element to be operated to operate said element; and a trigger mechanism for opening said valve means; said means for releasing power fluid including a valve member and means resiliently urging said valve member toward closed position; said trigger mechanism including a trigger piston movable into contact with said valve member to move said valve member to open position, said trigger mechanism including a trigger shaft for moving said trigger piston, a handle on said shaft, said handle being connected for limited pivotal movement about said trigger shaft and means biasing said handle for pivotal movement about said shaft.

4. A power device comprising: a power fluid reservoir; a second reservoir for a compressible fluid; a power piston in said second reservoir urged in one direction by said compressible fluid; means for transferring power fluid from said power fluid reservoir to said second reservoir to move said power piston in the opposite direction against the force exerted by said compressible fluid; valve means for releasing power fluid from said second reservoir to an element to be operated to operate said element; and a trigger mechanism for opening said valve means; said means for releasing power fluid including a ball valve, and means resiliently urging said ball valve toward closed position; said trigger mechanism including a trigger piston movable into contact with said ball valve to move said ball valve to open position; said trigger mechanism including a trigger shaft for moving said trigger piston, a handle on said shaft, said handle being connected for limited pivotal movement about said trigger shaft, and means biasing said handle for pivotal movement about said shaft, said trigger shaft having an offset extension extending into a diagonal slot provided in said trigger piston whereby a limited rotation of said trigger shaft in one direction first moves the trigger piston away from said ball valve and then toward said ball valve, said spring urging said trigger shaft and said handle to rotate in said one direction.

5. A power device comprising: a power fluid reservoir; a second reservoir for a compressible fluid; a power piston in said second reservoir urged in one direction by

said compressible fluid; a body between said reservoirs having a pump means for transferring power fluid from said power fluid reservoir to said second reservoir to move said power piston in the opposite direction against the force exerted by said compressible fluid; a ball valve for releasing power fluid from said second reservoir to operate an element to be operated; a trigger mechanism mounted on said body for opening said ball valve, said trigger mechanism including a trigger piston slidably mounted in a bore provided in said body and movable into contact with said ball valve to open said ball valve, said body having a passage communicating with said second reservoir and said bore whereby the pressure differential on opposite sides of the piston and the ball valve is equalized.

6. A power device comprising: a power fluid reservoir; a second reservoir for a compressible fluid; a power piston in said second reservoir urged in one direction by said compressible fluid; a body between said reservoirs having a pump means for transferring power fluid from said power fluid reservoir to said second reservoir to move said power piston in the opposite direction against the force exerted by said compressible fluid; a ball valve for releasing power fluid from said second reservoir to operate an element to be operated; a trigger mechanism mounted on said body for opening said ball valve, said trigger mechanism including a trigger piston slidably mounted in a bore provided in said body and movable into contact with said ball valve to open said ball valve, said body having a passage communicating with said second reservoir and said bore whereby the pressure differential on opposite sides of the piston and the ball valve is equalized, said trigger mechanism including a rotatable shaft connected to said piston for moving said piston into contact with said ball valve, and a valve means operated by said rotatable shaft for permitting return flow of power fluid, released from said second reservoir to said power fluid reservoir after said ball valve has returned to closed position after each movement to open position.

7. A power device for hand tools comprising: a power reservoir having a pressure member movable therein; biasing means in said power reservoir biasing said pressure member for movement in one direction; a drive fluid reservoir; means for transferring fluid drive from said drive fluid reservoir into said power reservoir to move said pressure member in the opposite direction against the force exerted by said biasing means; a barrel for receiving drive fluid conducted from said power reservoir; means for conducting drive fluid from the power reservoir to said barrel; a member slidable in said barrel and movable in one direction by said drive fluid conducted from said power reservoir and confining said drive fluid in said barrel; valve means controlling release of said drive fluid from said power reservoir to said barrel; means communicating with said barrel between said valve means and said slidable member and also communicating with said drive fluid reservoir for conducting fluid from said barrel to said drive fluid reservoir; and a sleeve telescoping over said barrel and having a stop engageable with said member slidable in said barrel for limiting movement of said member in said one direction.

8. A power device for hand tools comprising: a power reservoir having a power member engageable therein; means for introducing a compressible fluid into said reservoir to bias said power member for movement in one direction; a drive fluid reservoir; means for transferring drive fluid from said drive fluid reservoir into said power reservoir to move said power member in the opposite direction against the force exerted by said compressible fluid; means for conducting drive fluid from the power reservoir to an element to be operated, said element to be operated including a barrel for receiving drive fluid conducted from said power reservoir; a member slidable in said barrel and movable in one direction by said drive

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fluid; a sleeve telescoping over said barrel and having a stop for limiting movement of said member in said one direction; and spacer means carried by said barrel and engageable with said sleeve for holding said sleeve in extended position on said barrel.

9. A portable self-contained power device comprising: a power reservoir; a power applying member movable in said reservoir; a compressible pressure fluid confined in said reservoir on one side of said movable member; a substantially incompressible drive fluid confined in said reservoir on the opposite side of said movable member; an elongate barrel; a plunger slidably mounted in said barrel; means for conducting drive fluid from said reservoir to said barrel for applying the pressure of said compressible pressure fluid through said drive fluid to said plunger; first valve means in said conductor means controlling flow of drive fluid from said reservoir to said barrel, means for opening said valve means to permit substantially instantaneous application of full pressure of said pressure fluid to said plunger to cause a sudden movement thereof; a conduit member communicating with said barrel between said valve means and said plunger and

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with said power reservoir on said opposite side of said movable member for conducting drive fluid from said barrel to said power reservoir; and second valve means in said conduit member controlling flow of drive fluid through said conduit member and a member having means thereon for operating said first and said second valve means and disposed to open said first valve means after said second valve means has been closed.

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