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PRESSURE FLUID DRIVEN TOOL

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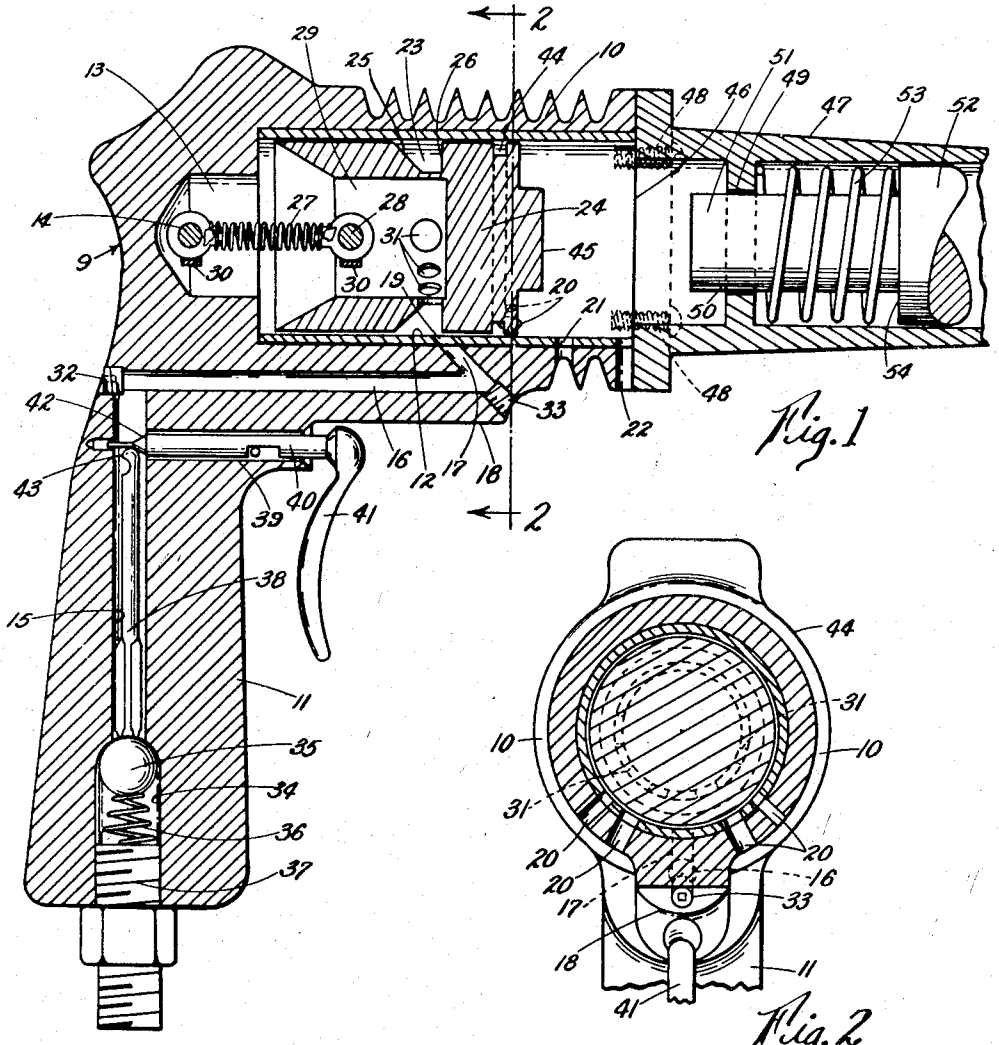


Fig. 1

Fig. 2

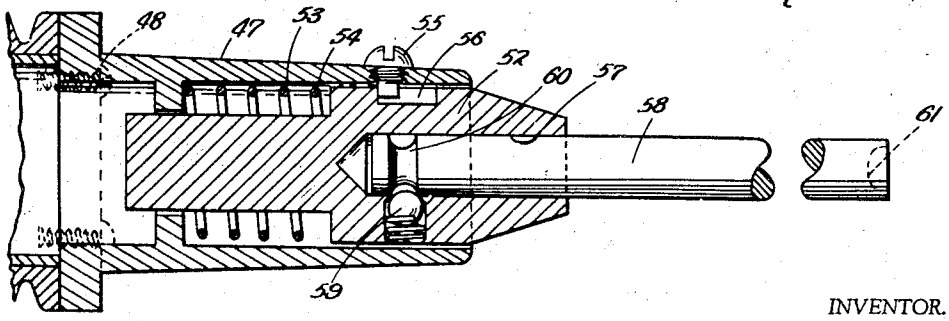


Fig. 3

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PRESSURE FLUID DRIVEN TOOL

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1 Claim. (Cl. 121—17)

The present invention relates to pneumatic or pressure fluid driven motor tools or the like, and has for an object the provision of a structure which is ideally adaptable to use in hand tools wherein extremely high speed reciprocation may be translated into work impact blows or into other mechanical motion for performing useful work.

A further object of the invention is to provide a lightweight and inexpensively manufactured device of this class wherein remarkably rapid reciprocation and easily controlled degrees of impact or applied force are attained without appreciable vibration of the casing of the device.

Another object of the invention is to provide a device of this kind which is adaptable for use as a self-centering and easily controlled riveting hammer which is particularly suited for rivet joining of sheet metal; for example, in the construction of metal aircraft and kindred work.

A still further object of the invention is to provide a device that is adaptable to a wide variety of power uses requiring or utilizing very high speed reciprocatory movement.

These and other objects are attained by the means described herein and exemplified in the accompanying drawing, in which:

Fig. 1 is a longitudinal cross-sectional view through a pneumatic tool embodying the invention, part being broken away.

Fig. 2 is a cross-sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a fragmental, longitudinal sectional view illustrating a simple method of removably mounting a tool, such as a riveting tool in the device of Fig. 1.

The device illustrated comprises a casing 9 consisting of a barrel or cylinder portion 10 and a pistol grip handle 11. The casing may be a one-piece member of cast metal or it may be made from one of the stronger pressure molded plastic materials. I have shown a bronze bearing liner 12 about which the casing material is cast. It should be understood that the choice of materials for the casing is optional to a large degree and that the use of hard molded plastic material affords considerable economy of and speed of production of the devices. The barrel portion 10 of the casing has at its rear a well 13 of reduced diameter which is traversed by a removable pin 14, the ends of which are seated in the opposite sides of said barrel. The handle grip 11 has a cored hole 15 which extends from the bottom thereof upwardly for a distance where it communicates with a transverse cored hole 16 which parallels the liner 12 just below the bottom thereof. A drilled hole or passage 17 extends angularly from the front of rib 18 on the bottom of the barrel inwardly towards the rear of cylindrical portion 10 and it communicates with the inside of the bronze bearing liner forming an inlet port 19 in the cylinder wall. Forwardly of the inlet port 19 the cylinder has a plurality of exhaust ports 20—20 distributed through part of a circumference. Forwardly of ports 20 I provide one or more vents such as 21 and 22. The distance between inlet port 19 and exhaust ports 20 is arranged to substantially equal the width of an annular groove 23 in a hollow piston 24 which is freely reciprocable within the cylinder or bore provided by the inside of the bearing liner 12. I prefer that the fit of piston 24 in the cylinder bore be a fairly loose one, commonly referred to as a sloppy fit so that during reciprocation a film of the motive pressure air surrounds the piston. The rear wall 25 of annular groove 23 slopes towards the rear end of the piston while the forward wall 26 of said groove is abrupt and preferably at right angles of the axis of the piston. In view of the foregoing and by reference to Fig. 1, it will be apparent that during reciprocation of the piston, the circumferential wall of the piston will alternately pass over and substantially close the inlet and exhaust ports and that the annular groove 23 will alternately communicate with the said inlet and outlet ports 19 and 20.

Mounted at one end on pin 14 are several springs 27 which have their opposite ends mounted on a cross pin 28 inside the hollow rear opening 29 of the piston. Pin 28 has its opposite ends seated in the wall of the piston skirt. I prefer to connect the ends of the springs 27 together as by strips 30 to facilitate assembly of the tool and for the purpose of holding the springs in parallel relation so that uniform spring action obtains at all times. The piston wall is provided with a plurality of drilled holes 31 which establish communication between the hollow interior of the piston and the annular groove 23.

The exterior terminal ends of holes 16 and 17 are closed by plugs 32 and 33, respectively. In order to provide for the controlled admission of pressure fluid to the cylinder, the lower end of hole 15 is enlarged to provide a valve chamber 34 at the bottom end of the handle. The valve chamber contains a ball valve 35 urged to close the hole 15 by pressure of spring 36 which is seated upon the end of a nipple 37 which is screw threaded into the handle. An actuating rod 38 seats in the hole 15 and rests upon ball 35 but it does not preclude the free passage of fluid pressure through the hole 15. Mounted for limited reciprocation in a bore 39 is a trigger rod 40 having a finger piece 41 at the external end and a tapered shoulder 42 at the opposite end where bore 39 communicates with hole 15. The upper end of rod 38 is rounded, as at 43, so that it cooperates with the tapered shoulder 42 of trigger rod 40 enabling the user to squeeze the finger piece 41 of the trigger and convert such pressure

into a downward movement of rod 38 which unseats ball valve 35 against the resistance of its spring to admit fluid pressure from a suitable source (not shown) by way of the nipple 37.

From the foregoing it will be apparent that the conveniently shaped and balanced tool is subject to easy control by the hand of the user who manipulates the tool. The operation of the structure thus far described is as follows: Assuming the trigger piece 41 to be depressed and the ball valve 35 unseated, allowing the flow of pressure fluid to pass through holes 15, 16 and 17, the fluid will initially enter annular groove 23 because the springs 27 tend to position piston 24 so that said groove is in at least partial registry with the port 19. The fluid passes through the groove 23 and holes 31 into the hollow interior 29 of the piston and the rear end of the cylinder bore constituted by part of the liner 12 and the well 13. This pressure rapidly urges piston 24 forwardly and in doing so exerts increasing tension on the springs 27. Air in the cylinder ahead of the piston is precluded from compression by the provision of such vents as 21 and 22. When the forward wall 26 of the annular groove reaches exhaust ports 20, the fluid pressure, which has built up behind the piston, is exhausted with great rapidity and at the same time the skirt portion of the piston has closed off the inlet port 19. The exhaust of the built up pressure through exhaust ports 20 is very fast and I have found, on prolonged continuous operation of the tool, that the barrel remains substantially cold despite an almost incredible speed of reciprocation. This is apparently due to the expansion of the rapidly unloaded pressures which are built up in the tool, functioning in accordance with well known principles of refrigeration.

The piston 24 has a groove 44 in which an oilless ring (not shown) may optionally be used. At its forward end the piston has an integral impact boss 45 which moves from the position shown in Fig. 1 to about the front end 46 of the barrel 10 on the power stroke of the piston.

On the front of the barrel 10 a sleeve 47 is removably secured, as by screws 48. The sleeve 47 has an internal annular shoulder 49, the center bore 50 of which slidably receives the reduced end 51 of a tool holder 52. A coil spring 53 surrounds the end 51 of the tool holder and the ends of the spring abut the shoulder 49 of the sleeve and shoulder 54 of the tool holder respectively, thus yieldably urging the end of the reduced portion 51 out of the range of the impact boss 45 during reciprocation of the piston.

A screw stud 55 in sleeve 47 has its end extending into a longitudinal slot 56 in tool holder 52 and permits the tool holder to be shifted back in the sleeve as the user pushes the device toward the work against the resistance of spring 53. The device is thus capable of positioning the end of portion 51 at an optimum position to receive the most effective impact from the piston. The holder 52 has a socket 57 in which a tool such as a riveting tool 58 is removably retained. A spring pressed ball in holder 53 enters a groove 60 in the tool to effect a simple and effective removable connection.

In use as a riveting gun (as illustrated) the hollow heading cup 61 in the inserted tool may be positioned over the end of a rivet to be headed up and is then yieldably held in a centralized position as the user presses the device toward the work. By an initially light pressure of the entire device, while holding the trigger piece 41 in, the user may proceed to position the tool without delivering any impact whatever. When the tool is properly positioned the user merely pushes the device further toward the now steadily positioned tool 58 until the rapidly reciprocating piston delivers the desired impact. The tool and the device are easily followed through to form a perfect driven head on a rivet. A sense of control of the device is quickly acquired by an inexperienced user by holding the device in the hand and pressing the end of an inserted tool such as 58 against a solid object several times. The user will quickly note that the tool may be firmly located on the work while the piston is reciprocating without delivering any impact to the work, and that the tool is thus properly located without actual or mental hazard. Thereafter the impact blows are delivered at an amazingly high rate by merely pressing the entire device a little more heavily toward the work against the resistance of the spring 53. Little effort is required to hold the device in the desired position during operation on the work because there is neither violent vibration nor kick-back on the casing. In riveting operations the user proceeds with confidence and ease due to the fact that by a slight withdrawal movement of the device or by the release of finger piece 41, or both, the delivery of impact blows to the tool 58 ceases instantly. Over-driving of rivets and damage to the work are avoided easily because of this double control which does not entail removal of the tool from its critical position on the work. It is practically impossible to stall the action of the device accidentally or otherwise.

The device is desirably operated on a constant fluid pressure source of from fifty to one hundred pounds. It is economical of power because of its remarkably rapid delivery of blows of regulated degrees of impact on the tool. The speed of reciprocation of the piston may be conservatively stated to exceed the rate of alternation of commercially available A. C. electric current supply.

In the design of the device it may be noted that within limits the increase of the sum total area of exhaust ports 20 increases the power of maximum attainable impact deliverable by the piston and also enables the use of weaker springs 27 for the piston.

Various modifications of structure and design are included within the spirit of the invention and the scope of the appended claim.

What is claimed is:

In a self-cooling, and non-lubricated pneumatic hammer the combination of a casing having a cylindrical bore, and inlet and exhaust ports respectively communicating with the bore in the periphery thereof, a loosely fitting hollow piston open at its rear reciprocably mounted in said bore in the casing and provided with an annularly grooved portion provided with ports communicating with the hollow interior and alternately communicating with said inlet and exhaust ports as the piston reciprocates, means exerting a yieldable axial retracting pressure on said piston and means for controlling a flow of motive pressure air to said inlet port, said piston adapted for reciprocation in non-contacting and pressure air lubricated relation to said cylindrical bore.

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