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J. R. HOFFMAN

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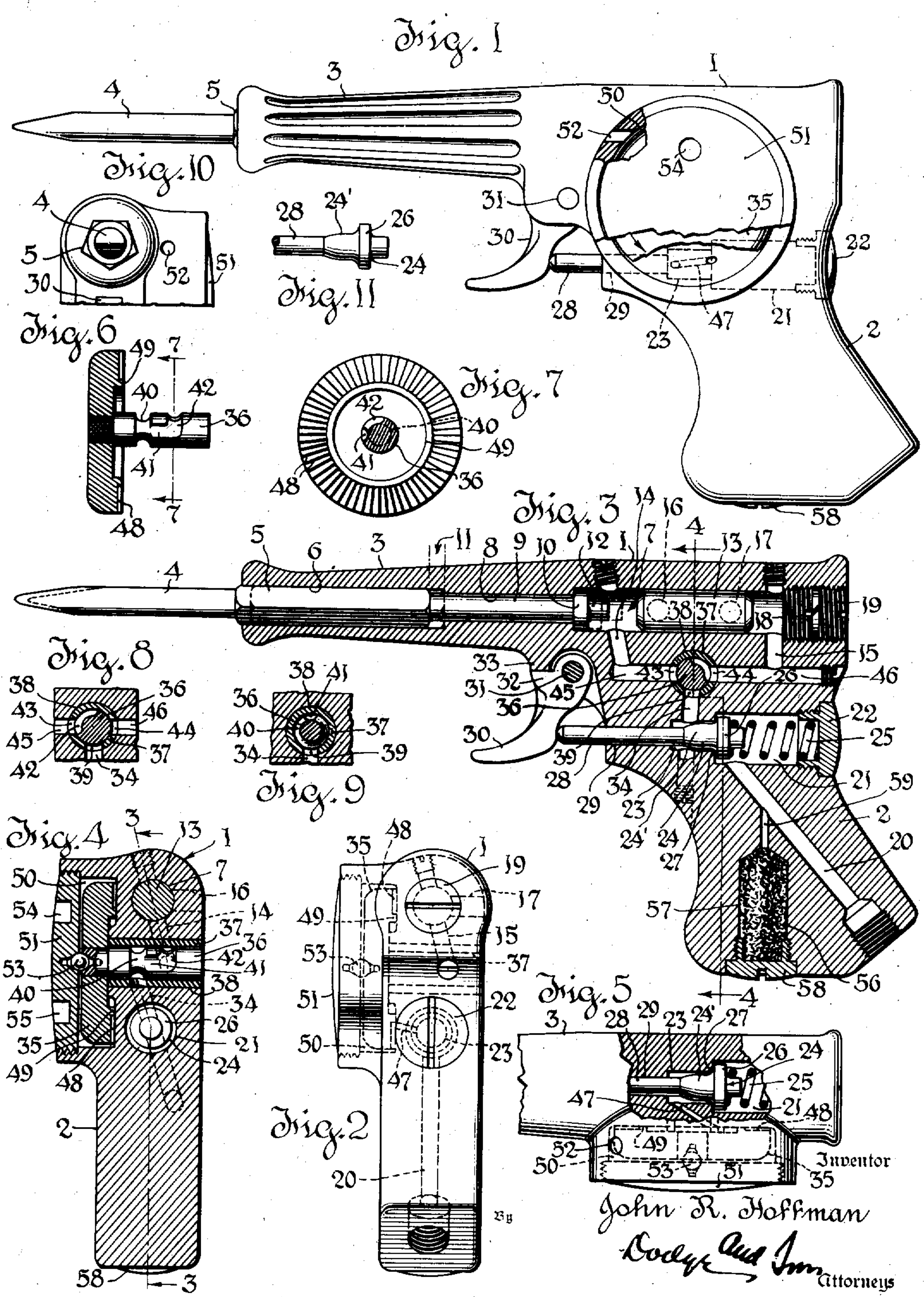

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FLUID OPERATED TOOL

John R. Hoffman, Madison, Wis., assignor to Madison-Kipp Corporation, Madison, Wis., a Corporation of Wisconsin

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2 Claims. (Cl. 121—20)

This invention relates to fluid pressure operated tools and especially to those of the impact or percussive type.

It is the primary purpose to provide a small, practical tool of the character mentioned. The particular embodiment of the invention illustrated and described is a reciprocating-type chisel adapted for shop or general use. However, it is to be understood that the invention is not limited to this type of tool, but obviously may be applied to many other types of fluid pressure operated tools and devices.

In order to facilitate handling and operation of the tool with a minimum of effort, the body thereof is designed to simulate a pistol or revolver, while the lightest metals possible, consistent with efficiency, are used in the manufacture of the parts.

An important object of the invention is the provision for increased speed of operation of the tool. Hence, automatic means, particularly adapted to operate at a high speed, have been designed for directly and accurately controlling the pressure fluid which actuates the hammer or piston.

Further improvements include a special type of throttle or pressure fluid supply valve and the operating means therefor. Increased efficiency in the operation of the piston hammer also is provided for in the designing of the hammer chamber and associated parts.

Reference is had to the accompanying drawing, in which:—

Fig. 1 is a side elevation of the improved tool;

Fig. 2, a rear elevation thereof;

Fig. 3, a section taken on line 3—3 of Fig. 4, showing the segmental groove in the turbine runner shaft in position to feed motive fluid to the right hand end of the hammer cylinder;

Fig. 4, a section taken on line 4—4 of Fig. 3 with the parts in the same position;

Fig. 5, a fragmentary plan view, portions of the tool being broken away to show the throttle or control valve;

Fig. 6 a longitudinal sectional view of the turbine runner mounted on its fluid distributing shaft;

Fig. 7, a section taken on line 7—7 of Fig. 6, the turbine shaft being in the position of Figs. 3 and 4;

Fig. 8, a fragmentary section, similar to Fig. 3, with the segmental groove in the turbine shaft in position to feed motive fluid to the left end of the hammer cylinder;

Fig. 9, a similar view taken in a plane passing through the annular groove in the turbine shaft, the latter being shown in the position of Fig. 8;

Fig. 10, a fragmentary front elevation of the tool; and

Fig. 11, an enlarged fragmentary side elevation of the throttle valve.

In the drawing, the body 1 of the tool, which preferably is a die-casting of zinc or other suitable light metal, is formed with a handle or stock 2 and a barrel 3. As appears best in Fig. 1, the tool body is designed so as to closely simulate a standard type pistol or revolver. The "pistol grip" thus provided greatly facilitates ready and accurate handling of the tool by the operator under all conditions.

Located in the outer end of barrel 3 is the chisel or other steel 4 which is adapted to be reciprocated therein by fluid pressure operated means hereinafter described. Shank 5 of the chisel is of polygonal shape in cross section, preferably pentagonal.

As shown in Fig. 10, this shank fits the correspondingly shaped chamber 6 of the barrel. In this manner rotation of the chisel steel is prevented and the cutting end thereof always maintains a definite relation to the body of the tool.

A hammer cylinder 7 is formed in the main body of the tool. The front end thereof connects with barrel chamber 6 by an annular passage 8. A plunger or anvil 9 is mounted for reciprocation in passage 8, with a flange 10 thereon normally engaging the end of chamber 7, as shown in full lines in Fig. 3. Plunger 9 is of sufficient length to extend a short distance 11 into barrel chamber 6 and in contact with chisel 4.

A head 12 on the rear end of plunger 9 is adapted, when the tool is in use, to be forcibly engaged by hammer 13 as the latter is forced to the left by the motive fluid. Flange 10 being spaced from the end of cylinder 7 at this time, due to the operator forcing chisel 4 against the work (indicated in dotted lines in Fig. 3), hammer 13 will move plunger 9 to the left and thereby force chisel 4 into the work.

Hammer cylinder 7 is provided with forward and rear inlet ports 14, 15, leading to the pressure fluid distributing means to be described shortly. Forward and rear exhaust ports 16, 17, controlled by the floating piston or hammer 13, lead from the side of cylinder 7 to the atmosphere (see Figs. 2 and 4).

Screw plugs 18, 19 at the rear end of cylinder

7 provide for ready removal or insertion of plunger 9 and hammer 13, when desired.

The means for controlling supply of pressure fluid to the tool and distributing it to inlet ports 14, 15 will now be described. A supply passage 20 in the handle of the tool is adapted to be connected at its lower end by a flexible tube or the like to a source of pressure fluid, such as compressed air. The upper end of passage 20 opens into a valve chamber 21. The rear end of this chamber is closed by a slotted screw plug 22. Its forward end opens into a smaller chamber 23.

Communication between valve chamber 21 and chamber 23 is controlled by a throttle valve 24. A coil spring 25 interposed between plug 22 and head 26 of the valve serves to maintain the valve normally in closed position on its seat 27. Stem 28 of the valve is mounted for reciprocation in an opening 29 in the tool handle and projects slightly beyond the handle at its forward end. Here it is adapted to be engaged by a valve-actuating trigger 30 carried by a pivot pin 31 mounted in the body of the tool. Stops 32, 33 on the trigger and barrel 3, respectively, cooperate to hold the trigger in proper operating relation to the valve stem 28 when the throttle valve is closed.

With the arrangement described, operation of throttle valve 24 by trigger 30 permits pressure fluid entering valve chamber 21 from supply passage 20 to flow past the valve and into chamber 23. Thence, the fluid flows into an upright passage 34 to the fluid distributing means to be described shortly.

Throttle valve 24 is especially designed to permit accurate control of the fluid pressure and to prevent full pressure entering chamber 23 at once. This is accomplished by providing an enlargement 24' between head 26 and the stem of the valve. As best shown in Fig. 11, this enlargement comprises a longitudinally tapered and curved section which merges into an annular flat section near the valve head. Hence, during the initial opening movement of the valve, a constant, but small, quantity of pressure fluid will be released. This permits the fluid distributing means to start operating. The valve is then opened further, and the amount of fluid pressure delivered gradually increases until full pressure is admitted to the tool. Upon release of trigger 30, coil spring 25 immediately returns the trigger and valve 24 to the normal position of Fig. 3, and operation of the tool ceases.

The fluid distributing means for hammer cylinder 7 comprises primarily a turbine runner or rotor 35, a rotary shaft or valve 36 on which the runner is fixedly mounted, and a ported bushing or bearing 37 for the shaft. As viewed in Figs. 1 and 3, rotor 35 and its shaft are designed to rotate in a counterclockwise direction.

Bearing 37 is fixed in a transverse opening 38 in the tool body. An opening 39 in the under side of the bearing connects passage 34, leading from the pressure fluid supply, to an annular groove 40 in shaft 36. A longitudinal groove 41 in the shaft connects annular grove 40 with a segmental groove 42 also formed in the shaft. Thus, pressure fluid entering opening 39 in bearing 37, when throttle valve 24 is operated, passes into annular groove 40 from whence it flows through longitudinal groove 41 into segmental groove 42.

Provided in the sides of bearing 37 in alignment with segmental groove 42 are diametrically opposed ports 43, 44. Port 43 connects with a passage 45 leading to inlet port 14 at the left end of hammer cylinder 7. Port 44 opens into a similar passage 46 connecting with inlet port 15 at the right end of cylinder 7. Therefore, when rotor shaft 36 and its segmental groove 42 are in the position of Fig. 3, the pressure fluid flows from said groove through opening 44 and thence to the right end of cylinder 7 by way of duct 46 and inlet port 15. This forces hammer 13 to the left, until exhaust port 17 is uncovered, and thereby vents the pressure in the right end of the cylinder to atmosphere. This movement of hammer 13 causes it to deliver a blow to plunger 9. This blow is transmitted to the chisel 4 and thus the latter is forced into the work.

By this time, runner 35 will have been rotated, by means described shortly, to bring its shaft 36 into the position of Figs. 8 and 9. This places segmental groove 42 in communication with inlet port 14 of cylinder 7 through duct 45 and opening 43 in bearing 37. As a result, pressure fluid is admitted to the left end of cylinder 7 to force hammer 13 back to the right. The hammer during this movement opens exhaust port 16 and pressure fluid in the left end of cylinder 7 is vented to the atmosphere.

In the meantime, continued rotation of shaft 36 has brought segmental groove 42 back to the original position of Fig. 3 to effect movement of hammer 13 to the left again and to deliver a blow to plunger 9 and the chisel. Reciprocation of hammer 13 is continued as long as shaft 36 rotates and the speed of this hammer movement is dependent, therefore, upon the rate at which shaft 36 and its runner are rotated. The advantages of a rotary type valving means for this purpose, especially in a high speed tool, are obvious.

As will be noted from Figs. 3 and 8, the angular extent of segmental groove 42 is such that, when pressure fluid is flowing to cylinder inlet port 15, no fluid is admitted to inlet port 14, and vice versa. A further feature is the designing and proportioning of the parts so that there is a difference, as appears in Fig. 3, in the amount of free space between hammer 13 and the ends of its cylinder. The space at the left, as shown in the figure mentioned, is larger, so as to provide greater capacity for compressing fluid in this space when the hammer is forced to the left. This permits full use of the fluid pressure in the opposite end of the cylinder which is forcing the hammer to the left and against plunger 9. It is also important to note that the distributor valve releases equal quantities of motive fluid into both the front and rear ends of the hammer chamber. Thus, by reason of the greater volume of free space at the front end of the chamber, the return stroke of the hammer will be slower and less powerful than the working stroke. This materially reduces the amount of vibration which otherwise would be set up in effecting reversal of movement of the hammer.

In order to operate turbine runner 35, a small quantity of pressure fluid is led from chamber 23 by way of a duct 47 and ejected against buckets 48 of the runner. As shown in Fig. 1, the position of duct 47 is such as to cause the runner to rotate in a counterclockwise direction.

Annular rib 49 on the inner face of runner 35 prevents inward movement of the pressure fluid towards the rotor shaft. The fluid, after expending a substantial amount of its kinetic energy by impact against buckets 48, escapes at the periphery of the runner into chammer 50, in which the runner operates. This chamber is closed by a cover plate 51 threaded into the body of the tool, but an opening 52 in the side of the chamber (Fig. 1) permits the exhaust fluid from the runner 35 to escape to the atmosphere. A ball bearing 53, located in suitable seats formed in the end of shaft 36 and cover plate 51, serves to form an effective thrust bearing for the shaft. Cooling of this bearing and the runner is effected by the arrangement of the fluid inlet port 47 and exhaust port 52 substantially diametrically opposite each other in chamber 50. In this way the fluid is caused to circulate around the runner and bearing before leaving the chamber. Spanner wrench sockets 54, 55 are provided for removal and replacement of cover plate 51. When this plate is removed, ball bearing 53 or runner 35 and its shaft may be taken out readily for any necessary repairs or replacements.

In use, the tool is merely grasped in one hand in the same manner as one does a pistol, and is forced against the work, or to the left, as shown in Fig. 1. This tends to keep chisel 4 and plunger 9 to the right in the dotted line position of Fig. 3, so that, upon each movement of hammer 13 to the left, the plunger and the chisel are forced to the left against the pressure of the operator. The normal stroke of the chisel steel 4 is indicated by the distance 11 (Fig. 3), this being the amount plunger 9 is projected into barrel cylinder 6 by the hammer.

Generally, the operator's other hand is used to assist in guiding the tool, while trigger 30 is being manipulated to feed pressure fluid simultaneously to runner 35 and rotary valve or shaft 36. The relatively small amount of fluid admitted when throttle valve 24 begins its opening movement, acts immediately on runner 35 to rotate the shaft 36. This insures proper operation of the latter to admit full pressure to hammer cylinder 7 when the throttle valve is completely opened. By this time, shaft 36 is rotating at high speed and hammer 13 is being reciprocated at a correspondingly high rate. Should the turbine rotor stop on dead center, i. e., with segmental groove 42 out of registry with both inlet ports 43, 44, starting of the tool nevertheless, is insured by passage 47 leading directly to the motor.

One of the great advantages of using a rotary valve, such as is formed by shaft 36, is that the fluid pressure is accurately controlled thereby. Therefore, the rapidity of the impacts or movements of the floating hammer can be increased considerably over that of other types. That is particularly true of the ordinary floating piston ported arrangement which is rather limited in speed.

Lubrication is provided for by a lubricant-soaked felt or the like 56 located in a chamber 57 in the tool handle. A screw plug 58 closes the outer end of this chamber. The inner end connects by a duct 59 with pressure fluid inlet passage 20. With this arrangement, the incoming pressure fluid, when the tool is in operation, picks up a certain amount of lubricant from duct 59 and conveys it in the form of a mist to the various moving parts of the tool.

The tool is simple in construction, reliable in operation, and may be manufactured in large quantities at comparatively small cost. The distributing valve and its actuating means are designed to provide positive and accurate control of the motive fluid for the impact motor, thereby overcoming a source of weakness and unreliability in high speed devices of this character. While a practical tool has been illustrated and described herein, it is obvious to those skilled in the art that various changes in the construction may be made within the scope of the invention, except as the same may be limited by the appended claims.

What is claimed is:—

1. In a fluid-operated hand tool of the impact type, the combination of a tool body having a hammer chamber with inlet openings leading thereto; a hammer located in said chamber; impact-transmitting means located at the forward end of said chamber for engagement by the hammer; and means for distributing motive fluid to said inlet ports for reciprocating the hammer, the volume of free space in the forward end of said chamber being greater than that of the free space in the rear end of the chamber when the hammer is midway between its extreme positions.

2. In a fluid pressure impact hand tool, the combination of a tool body having a passage therein closed at its inner end and open at its outer end, said passage having an intermediate reduced portion dividing it into an inner hammer chamber and an outer steel socket; a hammer in said chamber; a steel in said socket abutting said reduced portion of the passage; and an anvil mounted for reciprocation in the reduced portion with the outer end of the anvil abutting the steel, the inner end of the anvil having a head located in the hammer chamber and spaced from said reduced portion for limiting outward movement of the anvil.

JOHN R. HOFFMAN.