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2,974,651

IMPACT TOOL

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7 Claims. (Cl. 123—7)

This invention relates to an impact tool capable of producing a single blow or impact, or successive impacts with a controlled time interval between each impact and a controlled force of impact—as distinguished from power drills, tampers and the like which are driven either pneumatically, electrically or by an explosive charge and which produce a series of rapid impacts of the same force or intensity.

The principal objects of the invention are to provide an impact tool of the above type which is efficient and reliable in operation and which is capable of producing an impact of controlled intensity, and to provide a tool which operates either on a gaseous, solid or a liquid fuel and which can be easily manipulated by the operator in places where access is difficult.

More specific objects are to provide a cutting tool suitable for trimming branches and similar operations, and to provide a cutting tool which has little recoil, thereby preventing the operator from being thrown off balance.

Further objects relate to various features of construction and will be apparent from a consideration of the following description and the accompanying drawings, wherein:

Fig. 1 is an axial section through the upper part of the tool;

Fig. 1a is an axial section through the lower part of the tool;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 2; and

Fig. 4 is a schematic diagram of the ignition system.

In accordance with the present invention our impact tool comprises a cylinder having at one end portion one or more vent openings and within the cylinder is a piston which is suitably connected with an operating instrumentality such as a cutting tool. A spring or the like yieldable means acts on the piston so as to urge it toward and normally hold it at or adjacent to the closed or opposite end of the cylinder. A fuel dispenser for a suitable fuel is carried by the tool and this may be in the form of an aspirator or the like for gaseous fuels, or an ejector or carburetor for liquid fuels, but in any case the dispenser may be provided with the usual adjustments to insure admitting an explosive charge into the cylinder and associated with the valve for exhausting spent gases from the cylinder in response to return movement of the piston. In addition, suitable ignition means such as a conventional spark plug may also be provided at the closed end portion of the cylinder, together with a suitable ignition circuit and a manual or automatically operated control switch.

Secured to the piston or piston rod is a retractor or other means for retracting the piston against the action of the spring from its position at the closed end of the cylinder to an intermediate position, and operating in conjunction with the retractor is a means for operating the fuel dispenser so that as the piston moves from its normal position to its intermediate position, it draws into

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the cylinder an explosive charge which may be varied in accordance with the movement or displacement of the piston. The ignition means may be automatically or manually operated to explode the charge, whereupon the piston is forced to the opposite end of the cylinder, thereby effecting the operation of the instrumentality connected with the piston or piston rod.

After having completed the explosion cycle, the piston is returned by the spring and the spent gases are exhausted. Where, as is preferred, the operation of the tool is controlled by a manually actuated member, the construction and arrangement of parts are such that the retractor, fuel dispenser and ignition means are sequentially operated, after which the spring becomes effective to return the piston to its normal position preparatory to the next operating cycle.

The operating instrumentality associated with the piston may be of any type requiring either a single impact, or successive impacts with a controlled time interval between each impact, or impacts of different intensity. Hence, the invention is not only useful in various cutting and shearing operations, but also as a hammer, stud driver, peening tool, etc. which usually require either a single accurately directed blow or impact, or successive impacts with a controlled time interval between each.

Referring to the accompanying drawings which show a tool designed for use in trimming branches and similar operations—the numeral 1 designates a cylinder having adjacent to its lower or outer end exhaust openings 2 and a closure 4 provided with a central opening 5 and a plurality of circumferentially spaced vents 6. The inner end of the cylinder is provided with a head 8 having a coaxial outwardly extending sleeve 10 and within the cylinder 1 is a piston 11 having a tubular rigid piston rod 12, the outer end of which projects through the opening 5.

Mounted on the head 8 is a fuel dispenser 14 which may be a conventional carburetor having a valve 15 which is normally held closed by a small spring 16 of low coercive force, but readily opens in response to the suction created by the outward movement of the piston 11. The carburetor 14 is connected by a line 17 to a fuel tank T mounted on the outside of the cylinder, as indicated in Figs. 2 and 3. A conventional spark plug 18 is carried by the head 8 and between the spark plug and carburetor is a spring loaded valve 20 which is held open by a rocker arm 21 (Figs. 1 and 2) when the piston is at its innermost position, as hereinafter more fully explained.

One end of an operating lever 24 is pivotally mounted on a bracket 25 secured to the inner end of the cylinder 1 and the central portion of this arm is bowed to accommodate the sleeve 10. Adjacent to its pivotal connection the lever 24 supports an inverted L-shaped resilient conductor 26 (Fig. 1) carrying a contact 27. A binding post 28 is connected with the conductor 26 and these parts are suitably insulated from the lever 24. A second binding post 30, carried by a bracket 31 secured to the cylinder 1, is connected with a fixed contact 32, both the binding post and contact being insulated from the bracket 31. A conductor connects the binding post of spark plug 18 with the high tension side of a spark coil 33 provided with a vibrating contact, and other conductors connect the binding posts 28 and 30 in series with the vibrating contact on the low tension side of the spark coil, as indicated in Fig. 4.

The lever 24 carries a pin 34 engageable with the underside of the rocker arm 21 as such lever approaches its return position shown in Fig. 1 to thus cause the pin 34 to swing the rocker arm 21 clockwise to hold the valve 20 open. When the lever 24 is swung clockwise a few degrees at the beginning of an operating stroke thereof, the pin 34 disengages the rocker arm 21 and allows the spring 35 to close the valve 20. When the

lever 24 is swung to its extreme clockwise position, the contact 27 engages the contact 32 to close the circuit to the spark plug 18 to ignite the explosive charge in the cylinder. In order to insure easy manipulation of the lever 24, a rearwardly extending handle 36 is provided.

Secured to the piston 11 is a retractor 40 (Fig. 1), the outer end of which projects through one of the vent openings 6 and is formed with a V-shaped recess which provides a ratchet tooth 42. One end of an L-shaped latch arm 44 is pivoted to the end of the lever 24 and the other end of this arm extends inwardly toward the retractor and is formed with a tooth 45 which provides a pawl engageable with the ratchet tooth 42, the construction and arrangement of parts being such that clockwise movement of the lever is effective to retract the piston 11 from its return position to an intermediate or firing position (broken lines of Fig. 1), but counterclockwise movement of the lever has no effect on the piston.

Mounted on the outer end of the cylinder 1 are spaced guides 43 (Figs. 1 and 2) between which the lower part of the arm 44 slides and a retainer pin 50, carried by these guides, projects through a slot 52 formed to the arm 44 to prevent the arm from being accidentally swung out of operating position. The lower edge of the arm 44 beneath the slot 52 is recessed to provide a cam surface 54 engageable by a cam pin 55 carried by one of a plurality of spaced aligned openings 56 formed in the guides 48. When the lever 24 is swung clockwise the recessed edge of the arm 44 rides on the cam pin 55 until it engages the cam surfaces 54, whereupon the arm 44 is swung outwardly a distance sufficient to disengage the pawl 45 from ratchet tooth 42, thus arresting further movement of the piston 11. By varying the position of the cam pin 55, the movement of the piston and hence the amount of explosive charge drawn into the cylinder and the intensity of the impact produced by the explosion may be varied. A tension spring 58, one end of which is secured to arm 44 and its other end to a pin carried by the cylinder 1, not only holds the parts in operative position, but also effects return movement of the lever 24.

Slidably mounted in the sleeve 10 and piston rod 12 is a spindle or ram 60, one end of which projects outwardly beyond the sleeve and its other end extends beyond the cylinder 1. A tubular casing 62, rigidly connected with the sleeve 10, envelopes the inner end of the spindle and provides a handle by means of which the tool is manipulated. Secured to the inner end of the spindle 60 is an adjustable washer carrying a resilient collar 64 which provides a bumper or stop engageable with an annular shoulder 65 formed on the inner end portion of the casing 62, the parts being firmly secured to the end of the spindle by locknuts 66.

The inner end of a tubular casing 70 (Fig. 1) is threaded into the opening 5 and its inner surface is accurately bored or finished to provide a guide for the piston rod 12. A collar or abutment 72 is pinned or otherwise suitably secured to the spindle 60 and is normally held in engagement with the end of the piston rod as hereinafter explained. The outer end of the casing 70 carries a guide plug 74 (Fig. 1a) which slidably supports the outer end portion of the spindle 60.

One end of a compression spring 76, circumposed about the spindle 60, acts against the collar 72 and its other end against the guide plug 74, the spring 76 being powerful enough merely to move the piston 11 to its innermost or return position. Circumposed about and in spaced relation to the spring 76 and collar 72, is a second compression spring 78, one end of which acts directly against the end of the piston rod and its opposite end against the plug 74, the spring 76 likewise being powerful enough merely to effect the return of the piston independently of the spring 76 in case the spindle were held in advanced position.

Secured to the inner end of the casing 70 is a protective sheath 80 (Fig. 1) which receives the retractor

and this sheath is formed with a longitudinal slot 81 to accommodate the end of the arm 44. Mounted on the outer end of the casing 70 is a J-shaped member 84 (Fig. 1a) formed with a longitudinally extending guide slot 85 which receives one edge of a cutter C rigidly secured to the end of the spindle 60. The curved end 86 of the member 84 is also slotted to receive the cutting edge of the cutter and this end provides an anvil-like work support against which the cutter operates. As here shown, the end 86 supports or engages a branch B to be severed, but it is to be understood that the particular size and shape of the support 86 will be governed by the material on which the tool operates.

A summary of the operation of the impact tool is as follows:

Assuming that the cam pin 55 is properly located to produce the desired piston displacement, that the ignition system and carburetor are properly connected, and that the parts are positioned as shown by the full lines of Figs. 1 and 1a with a branch B to be severed in the support 86—clockwise movement of the handle 36 causes the latch arm 44 to act on the retractor 40 so as to move the piston away from the head 8, the initial movement of the lever 24 causing the pin 34 to disengage the rocker arm 21 and consequently the valve 20 closes under the influence of the spring 35. As the piston 12 travels away from the head 8 it not only advances the spindle and cutter relative to the work support 86, but also draws in an explosive mixture from the carburetor 14, it being noted that the spring 16 is not sufficiently powerful to prevent the valve 15 from opening in response to the suction created by the piston.

As the piston approaches intermediate or firing position (approximately midway between the ends of the cylinder) the cam surface 54 engages the pin 55, thereupon disengaging the pawl and ratchet connection 42, 45 and arresting further movement of the piston. By this time a predetermined explosive charge has been drawn into the cylinder and the valve 15 closes under the influence of spring 16. Further movement of the handle 36 brings the contacts 27 and 32 together, whereupon the explosive charge is ignited and the piston is forced downwardly, carrying the spindle or ram 60 and cutter C outwardly against the action of the return springs 76 and 78 until the bumper 64 engages the shoulder 65 which limits further movement of the spindle. When the piston reaches its position farthest from the head 8, the bulk of the exploded charge is exhausted through the openings 2 and by releasing the handle 36, the lever 24 swings back under the influence of spring 58, causing the rocker arm to open the valve 20 preparatory to return movement of the piston. The impact of the cutter C on the branch B is usually sufficient to sever it, whereupon the springs 76 and 78 come into operation to effect the return movement of the piston, spindle and cutter. Since the valve 20 is now open the spent gases are scavenged and all parts restored to their original position ready for another operating cycle.

In event the cutter C fails to sever the branch B and became stuck, the spring 78 alone would effect the return movement of the piston, but the spring 76 would not be able to effect the return of the spindle 60 in which case the collar 72 would be held outwardly from the end of the piston a distance equal to the travel of the piston from intermediate position. However, all other parts would be positioned for another operating cycle and by swinging the handle clockwise a second explosion would take place with a result that the end of the piston rod would strike the collar 72 so as to complete the severing of the branch B, after which return movement of all parts would be effected as above described.

Where, as here shown, the work support 86 is fixed to the casing 70, the recoil which would otherwise be present is minimized and consequently the operator would not be thrown off balance. Moreover, the resilient bumper 64

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not only limits the stroke of the spindle, but also comes into operation only after complete severing takes place to reduce the shock. In this connection it will be observed that the bumper 64 is adjustable on the end of the spindle and by removing the casing 62 the proper adjustment may be quickly made so as to insure efficient, smooth operation. A further feature of the invention resides in the provision of the adjustable cam pin 55 which may be selectively positioned to vary the displacement of the piston and consequently the intensity of the impact produced by the spindle.

It is to be understood that this disclosure is for the purpose of illustration and that various changes and modifications may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. An impact tool for delivering impacts each of which is separately manually initiated, said tool comprising a cylinder, a piston member in said cylinder and movable in said cylinder, said piston member having a rest position at one end of said cylinder, manually controlled means including a movable member movable from a first position to a second position for moving said piston member away from said rest position to an intermediate position in said cylinder to provide an explosion chamber between said one end and said piston member, means for forming an explosive charge admixed with air in said chamber, ignition means actuated by movement of one of said members when said piston member reaches said intermediate position for causing explosion of said charge to thereby cause further movement of said piston member away from said rest position to produce an impact, means returning said movable member from said second position to said first position, an exhaust port in said one end of said cylinder, said exhaust port being open when said movable member is in said first position and being closed when said movable member is moved from said first position toward said second position, an operating instrumentality operated by said further movement of said piston member, and means for returning said piston member to said rest position and for holding said piston member in said rest position until again moved away from said rest position under manual control by said manual controlled means.

2. An impact tool for delivering impacts each of which is separately manually initiated, said tool comprising a cylinder, a piston member in said cylinder and movable in said cylinder, said piston having a rest position at one end of said cylinder, manually controlled means including a movable member movable from a first position to a second position for moving said piston member away from said rest position to an intermediate position in said cylinder to provide an explosion chamber between said one end and said piston member, means for forming an explosive charge admixed with air in said chamber, ignition means actuated by movement of said movable member when said piston member reaches said intermediate position for causing explosion of said charge to thereby cause further movement of said piston member away from said rest position to produce an impact, means returning said movable member from said second position to said first position, an exhaust port in said one end of said cylinder, said exhaust port being open when said movable member is in said first position and being closed when said movable member is moved from said first position toward said second position, an operating instrumentality operated by said further movement of said piston member, and resilient means for returning said piston member to said rest position and for holding said piston member in said rest position until again moved away from said rest position under manual control by said manual controlled means.

3. An impact tool for delivering single impacts each of which is separately manually initiated, said tool com-

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prising a cylinder, a piston reciprocable in said cylinder and having a rest position at one end of said cylinder, manually controlled means movable from a first position to a second position for moving said piston away from said rest position to an intermediate position in said cylinder to provide an explosion chamber between said one end and said piston, means for forming an explosive charge of fuel admixed with air and introducing said charge into said chamber during said moving of said piston, igniting means actuated by said manually controlled means when said piston reaches said intermediate position for causing explosion of said charge to thereby cause further movement of said piston away from said rest position to produce an impact, means returning said movable member from said second position to said first position, an exhaust port in said one end of said cylinder, said exhaust port being open when said movable member is in said first position and being closed when said movable member is moved from said first position toward said second position, an operating instrumentality operated by said further movement of said piston, and resilient means for returning said piston to said rest position and for holding said piston in said rest position until said piston is again moved away from said rest position by said manually controlled means.

4. An impact tool for delivering impacts each of which is separately manually initiated, said tool comprising a cylinder, a piston movable in said cylinder and having a rest position at one end of said cylinder, piston moving means movable from a first position to a second position for moving said piston away from said rest position to a position spaced from said rest position to provide an explosion chamber between said piston and said one end, charge forming means for forming an explosive charge of fuel admixed with air in said chamber, manually controlled means actuatable to initiate the operation of said tool to cause said piston moving means to move said piston away from said rest position and cause said charge forming means to form said charge in said explosion chamber, igniting means for igniting said charge, means operating as a result of actuating said manually controlled means and immediately after the formation of said charge for actuating said ignition means to cause an explosion of said charge to thereby move said piston further away from said rest position and provide an impact, means returning said piston moving means from said second position to said first position, an exhaust port in said one end of said cylinder, said exhaust port being open when said piston moving means is in said first position and being closed when said piston moving means is moved from said first position toward said second position, and resilient means for returning said piston to said rest position in said cylinder and for holding said piston in said rest position until said manually controlled means is again actuated to cause said piston moving means to move said piston away from said rest position.

5. An impact tool for delivering impacts each of which is separately manually initiated, said tool comprising a cylinder, a piston member reciprocable in said cylinder and having a rest position at one end of said cylinder, manually controlled means having a movable member movable from a first position to a second position for moving said piston member away from said rest position to an intermediate position in said cylinder to provide an explosion chamber between said one end and said piston member, charge forming means for introducing an explosive charge of fuel admixed with air into said chamber during said moving of said piston member, igniting means actuated by movement of one of said members when said piston member reaches said intermediate position to explode said charge and thereby cause further movement of said piston member away from said rest position to produce an impact, means returning said movable member from said second position

to said first position, an exhaust port in said one end of said cylinder, said exhaust port being open when said movable member is in said first position and being closed when said movable member is moved from said first position toward said second position, an operating instrumentality operated by said further movement of said piston member, and resilient means for returning said piston member to said rest position in said cylinder and for holding said piston member in said rest position until said piston is again moved away from said rest position by said movable member of said manually controlled means.

6. An impact tool for delivering impacts each of which is separately initiated, said tool comprising a cylinder, a piston member reciprocable in said cylinder and having a rest position at one end of said cylinder, manually controlled means having a movable member movable from a first position to a second position for moving said piston member away from said rest position to an intermediate position in said cylinder to provide an explosion chamber between said one end and said piston member, charge forming means for producing an explosive charge of fuel admixed with air and including an inlet valve through which said charge is drawn into said chamber during said moving of said piston member, igniting means actuated by one of said members when said piston member reaches said intermediate position to explode said charge and thereby cause further movement of said piston member away from said rest position to produce an impact, means returning said movable member from said second position to said first position, an exhaust port in said one end of said cylinder, said exhaust port being open when said movable member is in said first position and being closed when said movable member is moved from said first position toward said second position, an operating instrumentality operated by said further movement of said piston member, and resilient means for returning said piston member to said rest position and hold-

ing said piston in said rest position until again moved away from said rest position by said movable member of said manually controlled means.

7. An impact tool for delivering impacts each of which is separately manually initiated, said tool comprising a cylinder, a piston member reciprocable in said cylinder and having a rest position at one end of said cylinder, manually controlled means having a member movable from a first position to a second position for moving said piston member away from said rest position to an intermediate position in said cylinder to provide an explosion chamber between said one end and said piston member, charge forming means including an inlet valve for introducing an explosive charge of fuel admixed with air into said chamber during said moving of said piston member, igniting means actuated by one of said members when said piston member reaches said intermediate position to explode said charge and thereby cause further movement of said piston member away from said rest position to produce an impact, means returning said movable member from said second position to said first position, an exhaust port in said one end of said cylinder, said exhaust port being open when said movable member is in said first position and being closed when said movable member is moved from said first position toward said second position, an operating instrumentality operated by said further movement of said piston member, and resilient means returning said piston member to said rest position at said one end of said cylinder and holding said piston member in said rest position until again moved away from said rest position by said manually controlled means.

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UNITED STATES PATENT OFFICE
CERTIFICATION OF CORRECTION

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Carleton S. Marden et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, list of references cited, add the following:

2,727,497 Wampach -----Dec. 20, 1955

Signed and sealed this 25th day of July 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents