(No Model.)

W. M. WOOD.

PNEUMATIC TOOL.

No. 443,029. Patented Dec. 16, 1890.

Fig. 1.

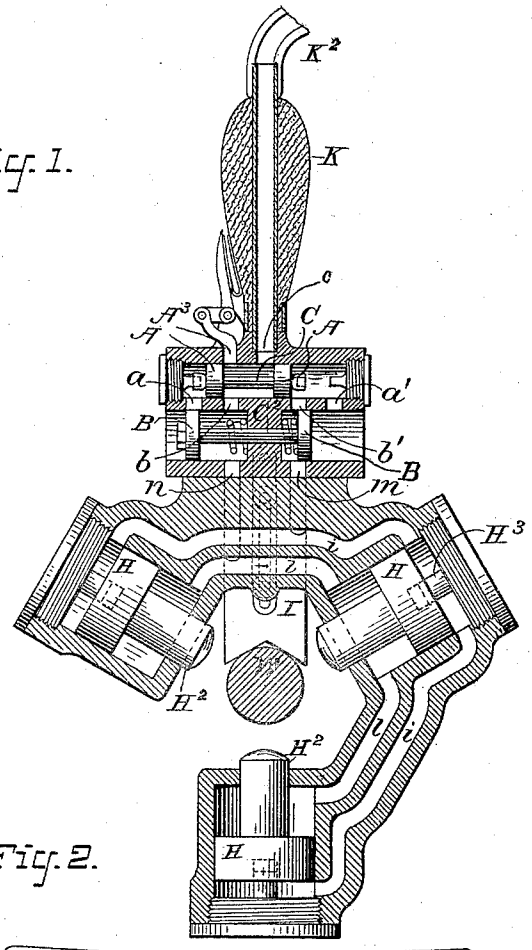
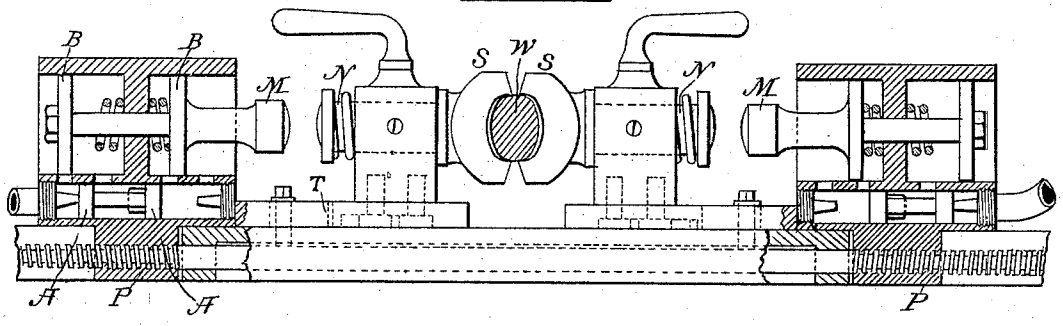


Fig. 2.



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PNEUMATIC TOOL.

SPECIFICATION forming part of Letters Patent No. 443,029, dated December 16, 1890.

Application filed March 28, 1890. Serial No. 345,766. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. WOOD, a citizen of the United States, and a resident of Washington, in the District of Columbia, have invented a certain new and useful Pneumatic Tool, of which the following is a specification.

My invention relates to pneumatic tools of the class in which hammers, dies, swages, cutters, or other instruments are operated by rapidly-repeated movements of a piston or plunger actuated by the pressure of air, gas, steam, or other fluid under pressure.

My invention is designed particularly for use in instruments employed for reducing the burr or expansion at the weld formed between two pieces of metal by the ordinary process of electric welding, in which end pressure is employed, though the novel features of construction and combinations of devices hereinafter described and claimed are many of them useful in pneumatic tools generally.

One of the objects of my invention is to provide a simple and effective instrument which may be used in reducing the burr at an electrically-formed weld by means of rapidly-delivered blows from two or more hammers or dies.

Another object of my invention is to provide a simple and effective controlling-valve whereby the action of the gas or fluid under pressure in operating the hammers or other instruments may be controlled.

My invention consists in the combinations of parts and details of construction hereinafter described in connection with the accompanying drawings.

My invention consists, also, in the novel combination of two reciprocating pistons, which may act as the valve-movement for controlling the fluid-pressure upon the pistons or plungers carrying the tools or may be used for actuating a tool directly.

In the accompanying drawings, Figure 1 is a vertical central section through an apparatus embodying my invention. Fig. 2 is a vertical longitudinal section and partial side elevation of another form of my invention, and shows the application of the automatic valve-movement to the operation of a hammer or die directly.

Referring to Fig. 1, H H H indicate three plungers or pistons working in cylinders and adapted to be reciprocated by fluid-pressure applied alternately at opposite sides of the piston through chambers or passages *i l*. The plungers H carry hammers or other tools H^2 and operate on radial lines converging or meeting in the work, such as a piece of metal W to be hammered or to have a burr upon its exterior reduced. The passages *i i* all connect with a port, as *m*, to be presently described, through which the air, gas, steam, or other fluid under pressure is delivered through the passages and to the cylinders at one side of the pistons, while the passages *l* connect with a similar port *n*, for delivering air or other gas or fluid under pressure to the opposite side of the piston. The pressure at ports *m n* is controlled by a valve-movement, as will be presently described. Instead of a valve controlling the admission of air, gas, steam, or other fluid under pressure any other means might be used for producing pressure at opposite sides of the pistons H alternately. In the preferred form of my invention the ports *m n* serve also as the exhaust-ports.

The plungers H may be cushioned on their back throw by means of projections H^3 from the cylinder-heads, which projections are adapted to fit into air cups or cavities in the piston-heads or plungers, as indicated.

By using the three hammers placed radially, as shown, at distances one hundred and twenty degrees apart a revolution of the tool one-third the circumference of the work will cover the whole surface to be operated upon. For the purpose of adjusting the hammers for different-sized work, so that they shall be normally equidistant from the center, I provide a slide, guide, or gage I, fixed to the stock or casting uniting the cylinders for plungers H and adapted to engage with the work, as indicated. As the hammers or tools H^2 are operated by independent plungers, their stroke may be proportionately great or short, according to the work they are operating upon, of course within the limitations of the capacity of a tool. Hence not only is the tool well adapted to different sizes of work, but oval or irregular work may be readily hammered or operated upon, one hammer

making a short stroke, while the others make longer ones.

The handle K, connected to the tool in any suitable manner, serves to move the same around the work. The air, gas, steam, or other fluid under pressure may be supplied through a flexible tube K^2, so that the free movement of the tool by hand may not be interfered with.

The cylinders for the several plungers may be formed in a common casting, in which the passages *l i* are also formed by casting, or the cylinders might be separately formed and mounted and connected with a common source of pressure through pipes or passages in any other desired manner.

An automatic valve-movement suitable for producing the desired pressure and exhaust for plungers H H may be made as follows:

A A is a double-acting piston working in a suitable chamber, as shown, and kept in operation by air or fluid pressure admitted alternately at opposite ends of the cylinder through the ports *a a'*. The piston-heads A are connected by a rod C, thus leaving a pressure-space, which is put in communication by the reciprocation of the piston alternately with the ports *b b'*. Air or gas under pressure is delivered to the space between the piston-heads through a port or opening *c*, which communicates by a pipe leading through the handle K with the tube K^2. Suitable stops are provided for the double piston A at the ends of the cylinder in which it works, and by suitable construction the piston may be cushioned at the end of a stroke by confining the air or gas under pressure in cavities or cups upon the piston-heads, which slip over projections on the cylinder-heads at the end of a stroke.

B B is a second double-acting piston, which is kept in operation by air or gas pressure admitted alternately through ports *b b'* to spaces at the inside of the piston-heads. The piston-heads are connected by a rod, as shown, working through a diaphragm, and the connecting-rod may have a packing at the point where it passes through the diaphragm, if desired, although this is not absolutely necessary, since a slight amount of leakage from one side to the other will not prevent the operation of the apparatus. Piston-heads B B alternately cover and uncover the ports *a a'* for admission of the air or gas under pressure to the cylinder in which the piston A works. This air or gas pressure is conveniently and preferably taken from the part of the cylinder for piston B B wherein the pressure exists for operating the latter. Piston B B may be cushioned at the end of each stroke by allowing the piston-heads to confine a small volume of air between the head and the diaphragm in obvious manner, and the cushioning action may be assisted by means of springs applied as shown should it be deemed desirable. These springs may also aid in reversing the movement of the piston. The cylinders for the two pistons are preferably formed in the same casting and are parallel with one another. The outer ends of the cylinders for the double piston B are left open to the outer air or to an exhaust-chamber, so that ports *a a'*, when uncovered by a movement of their piston B toward the central diaphragm, may form exhaust-ports for the cylinder in which the piston A works.

To make the operation of the two pistons A A B B, in the manner to be presently described, control the action of the plungers H H, it is simply necessary to put the ports *m n* in permanent connection with the spaces at the inner sides of the heads B B. The inlet and exhaust for the air or gas under pressure to the plungers H might be controlled by the movement of the pistons B B in any other desired way, though the arrangement shown is the preferable one. The movement of the pistons B B might also, as will be presently shown, instead of controlling the action of the air or gas for the purpose of operating the tool, actuate the tool itself directly and mechanically, or said piston might carry the tool itself in some forms of instruments, as will be presently described.

The operation of the valve or piston movement composed of the two pistons A A B B is as follows: In the position of the pistons shown the air passes by port *b* and port *a* to one side of piston A, the space at the opposite side of piston A being open through the port *a'* to the exhaust. The piston A is thereupon moved to the right with the effect of shutting off the air-pressure at port *b* from piston B and opening the port *b'* for communication with the source of air-pressure. At the same time the movement of the piston A is sufficient to open communication by port *b* with the space at the left-hand end of the cylinder for A, so that the air or gas may exhaust from the pressure-space at the left end of the double piston B as soon as said piston B moves slightly to the right and opens the port *a* at the rear side of the piston-head B. Piston B now moves to the right until, finally, it opens communication by way of port *a'* between the space at the inside of the right-hand piston B and the right-hand end of piston A to produce reverse movement, the exhaust at the opposite end of piston A taking place now through port *a*. Piston A by its reverse movement opens the port *b* for admission of air or gas under pressure to cause movement of piston B to the left, the exhaust for such piston B now taking place through port *b'*, which has been uncovered by the movement of A to the left, so that the exhaust may pass through the cylinder of A and out by port *a'*. The reversal of movement of the large piston B at each stroke is assisted by the spring as well as by the fact that the piston A, after covering port *b* or *b'* and so as to shut off the air-pressure from *b* and open the port *b* or *b'* as an exhaust, will, on continuation of its movement, produce rarefaction of the air or

gas which might be confined in the position of the piston B shown, thereby causing an inequality of the pressures tending to move the piston B after communication is established by way of port b' to the space at the inside of the right-hand piston-head B. It will be obvious that as the ports m n communicate with the spaces between the piston-heads B and the diaphragm C^2, where pressure and exhaust take place alternately, there will be in the passages i l and in the spaces at the opposite sides of the plungers H H H a condition of alternate pressure and exhaust or lowering of pressure, which will cause said plungers to reciprocate with the piston B. Thus when there is pressure in the space between one of the piston-heads B and the intermediate diaphragm tending to move said piston in one direction—as, for instance, in the space communicating by port n with the passages l—there will be at the same time exhaust-passages opened for the escape of the steam or other fluid under pressure from the space between the inner side of the other piston-head B and the intermediate diaphragm, so that the pressure in the passages i, communicating with port m, may be relieved. Under this condition the pistons H will move back away from the work through the pressure communicated through n and passages l, the exhaust taking place through i and m, b', and a'. When, however, the valve mechanism moves in the opposite direction through the pressure communicated to the space between the head B and the intermediate diaphragm, with which space port m communicates, there will be, as before described, an exhaust for the air, gas, steam, or other fluid under pressure in the space with which the port n communicates, so that under this condition of affairs pressure will now be communicated through m and passages i to the rear of the plungers H, while an exhaust will exist through the passages l, the port n, and the ports b a.

It will be observed that the ports b b' are pressure and exhaust ports for the double-acting piston B and are controlled by the action of the double-acting piston A A, so as to produce reciprocation of the piston B, while in the same manner the ports a a' are alternately inlet and exhaust ports for piston A and are controlled by the movements of B. Each piston operates, therefore, as a valve for controlling the inlet and exhaust of the other by means of two sets of ports a a' b b', and each piston moves in its own cylinder and is not, as in some previous constructions, carried by the other. It will be seen that the organization is extremely simple, and in practice I find that a perfectly automatic motion of great rapidity and absolute certainty is obtained whether such piston, or the valve-movement of one of said pistons, be applied to controlling admission of air or gas under pressure to other pistons or plungers, or whether the movement of one of said pistons be employed to actuate directly or indirectly any suitable tool.

By operating the tool by means of plungers H independent of the valve-movement I obtain the advantage that the stroke of the plunger carrying the tool may be variable and is entirely independent of the movement of the automatic piston-valves, where there is practically a fixed length of stroke.

It will be observed that by simply connecting the cylinders for the plungers H H with spaces or chambers of the automatic valve-movement where there is alternately a pressure and exhaust in the operation of such valve-movement I obtain the maximum of simplicity in the operation of a separate set of plungers carrying the tools by the controlling action of one of the pistons of the automatic valve-movement.

At A^3 is indicated a stop or catch adapted to engage with one of the valves of the piston-valve movement, so as to hold the parts in the position shown, where the air-pressure will be applied to the pistons or plungers H in a manner to hold the same raised away from the work and ready for use. When it is desired to start the tool into operation, the stop A^3 is removed by means of a lever applied in convenient position on the handle K, as shown.

In Fig. 2 I have shown the application of the automatic valve-movement to the operation of a striker or hammer which actuates a tool-carrying bar or spindle. Here one of the sets of pistons, as B B, carries the striker, as M, which operates on a tool-carrying spindle N. Two separate hammers or strikers are provided, operating on straight lines meeting in the work, which is represented at W as a bar or piece of metal subjected to the action of two swages S S, carried by the spindles or rods N N. The valve-movements and parts supporting the swages at each end of the machine are mounted on a suitable base-plate or support T, which slides on a frame or table. By means of a right and left hand screw P, applied as shown to the moving parts, the valve mechanisms, with the corresponding swages, may be caused to open or close at will. When operating on a piece of hot metal which has just been welded, as in an electric welding-machine, the strikers or hammers may be kept running all the time, and the swages gradually drawn in toward the work by a turn or two of the feed-screw as the work is reduced in size. When the hammering is finished, it is only necessary to reverse the feed far enough to move each hammer half the diameter of the work in order to remove it. In this arrangement the small piston-valve is placed underneath the two open cylinders which contain the main pistons, and the air is brought into a port which passes down one side and enters at the middle. In place of the swages S S other tools operating on the work might be employed, as is obvious.

While I have described the use of a right and left hand screw for moving the two parts

of the apparatus, Fig. 2, at opposite sides of the work, I do not limit myself to such device, as any other mechanical movement adapted to produce the motion described will obviously answer the purposes when properly connected to the slides carrying the pneumatic tool.

What I claim as my invention is—

1. The combination, in a pneumatic tool, of two or more plungers operating on lines meeting at a common point or center and each bearing or actuating a hammer or equivalent device, as described, a source of air, gas, steam, or other fluid under pressure, and a valve common to said plungers for controlling the passage of the steam or other fluid, so as to operate the plungers simultaneously.

2. In a pneumatic tool, the combination, with two actuating-plungers operating on converging or meeting lines, of a valve-movement independent of the motion of the plungers for controlling the air, gas, steam, or other fluid pressure which actuates them.

3. The combination, with the three hammer or die carrying plungers working on converging lines, of a stop or gage adapted to rest on the work for adjusting the hammers or tools to different sizes of work, as and for the purpose described.

4. The combination, with the tool-actuating plunger, of a valve-movement controlling the air, gas, steam, or other fluid pressure that actuates such plunger, and a catch for engaging with the valve-movement, so as to hold the same in position to permit the air or fluid pressure to keep the plunger lifted.

5. In a pneumatic tool, three or more plungers working on converging lines and each carrying a hammer or die at its inner side, and a flexible pipe or connection K^2, for conveying air, gas, steam, or other fluid under pressure to operate said plungers and to permit the same to be moved circumferentially around the work.

6. The combination, with the tool-carrying plunger, of the two reciprocatory piston-valves, each controlling in its movement the exhaust and inlet for the other, so as to keep the said pistons or valves in continued movement while air, gas, steam, or other fluid under pressure is supplied to them, and connections from opposite sides of the said tool-carrying plunger to chambers or spaces of the valve system where pressure and exhaust exist alternately, as and for the purpose described.

7. In a pneumatic tool, three tool-carrying plungers H H H, working on lines converging toward a common center and all having pipes or passages leading from opposite sides of the plungers and connecting each with a common source of air, gas, steam, or other fluid under pressure.

8. The combination, in a pneumatic tool, of two or more plungers working toward and from a common center, a hammer or other tool carried by each and adapted to engage with the work directly, a source of air, gas, steam, or other fluid under pressure common to said plungers, and an automatic valve mechanism operated by the pressure of the fluid and controlling the controlling-ports leading to the plunger-cylinders.

9. The combination, with the parallel double-acting pistons, of two pairs of ports connecting the chambers in which said pistons reciprocate, each pair being controlled by one of said pistons and forming alternately inlet and exhaust ports for the other.

10. The combination, substantially as described, of a piston B B, and a piston A, controlling the inlet-ports, whereby air, gas, steam, or other fluid is admitted to actuate the pistons B and ports $a\ a'$, which are alternately covered and uncovered by piston B, so as to admit air or gas under pressure to opposite sides of piston A alternately.

11. The combination, substantially as described, of a double-acting piston A, actuated by pressure applied upon its opposite ends alternately, a piston B B, actuated by pressure applied alternately through ports controlled by the piston A, and ports or openings which are alternately uncovered by the piston B, so as to place such ports in communication with the pressure spaces or chambers of piston B, so as to admit fluid under pressure for the operation of piston A.

12. The combination, substantially as described, of two parallel pistons A B, having their chambers connected by lateral ports with which said pistons coact, as described, so as to each control the exhaust and inlet of the other, as and for the purpose described.

13. The combination, substantially as described, of two reciprocatory double-acting pistons, ports or passages $b\ b'$, placed in communication alternately by one of said pistons with a source of air, gas, steam, or other fluid under pressure and leading to the pressure-spaces for actuating the second piston, and ports or passages, as $a\ a'$, communicating with the pressure-spaces of the first piston and alternately connected with the pressure-spaces of the second piston by movement of the latter.

14. The combination of the double-acting piston B B, having heads connected by a rod passing through a diaphragm and working in cylinders or chambers open at their outer ends, a piston A A, working in a chamber closed at its outer ends, ports $b\ b'$, controlled by the piston A and forming alternately inlet and exhaust ports for the piston B B, and ports $a\ a'$, controlled by piston B B and forming alternately inlet and exhaust ports for the piston A A as well as part of the exhaust-passages for the piston B B.

15. In a pneumatic tool, the combination, with shaping tools or instruments operating in the same line and on opposite sides of the work, of adjustable supports for each tool and means for moving said tools to and from one another simultaneously.

16. The combination, in a pneumatic tool, of the two swages or other instruments S S, applied to the work at opposite sides thereof, the two strikers M M, carried by reciprocating pistons or plungers, and an actuating right and left hand screw P P, for moving the parts of the apparatus simultaneously to and from the work, as and for the purpose described.

17. The combination, in a pneumatic tool, of a swaging or shaping instrument S, an actuating-piston therefor operated by air, gas, steam, or other fluid under pressure and mounted on an adjustable support, and swaging or forming tool S, mounted on an adjustable support at the opposite side of the work, and means for moving the two swages or forming-instruments away from or toward the work simultaneously.

Signed at Boston, in the county of Suffolk and State of Massachusetts, this 24th day of March, A. D. 1890.

WILLIAM M. WOOD.

Witnesses:
HENRY N. SWEET,
H. PERCY MAXIM.