

O. C. DURYEA & M. C. WHITE.

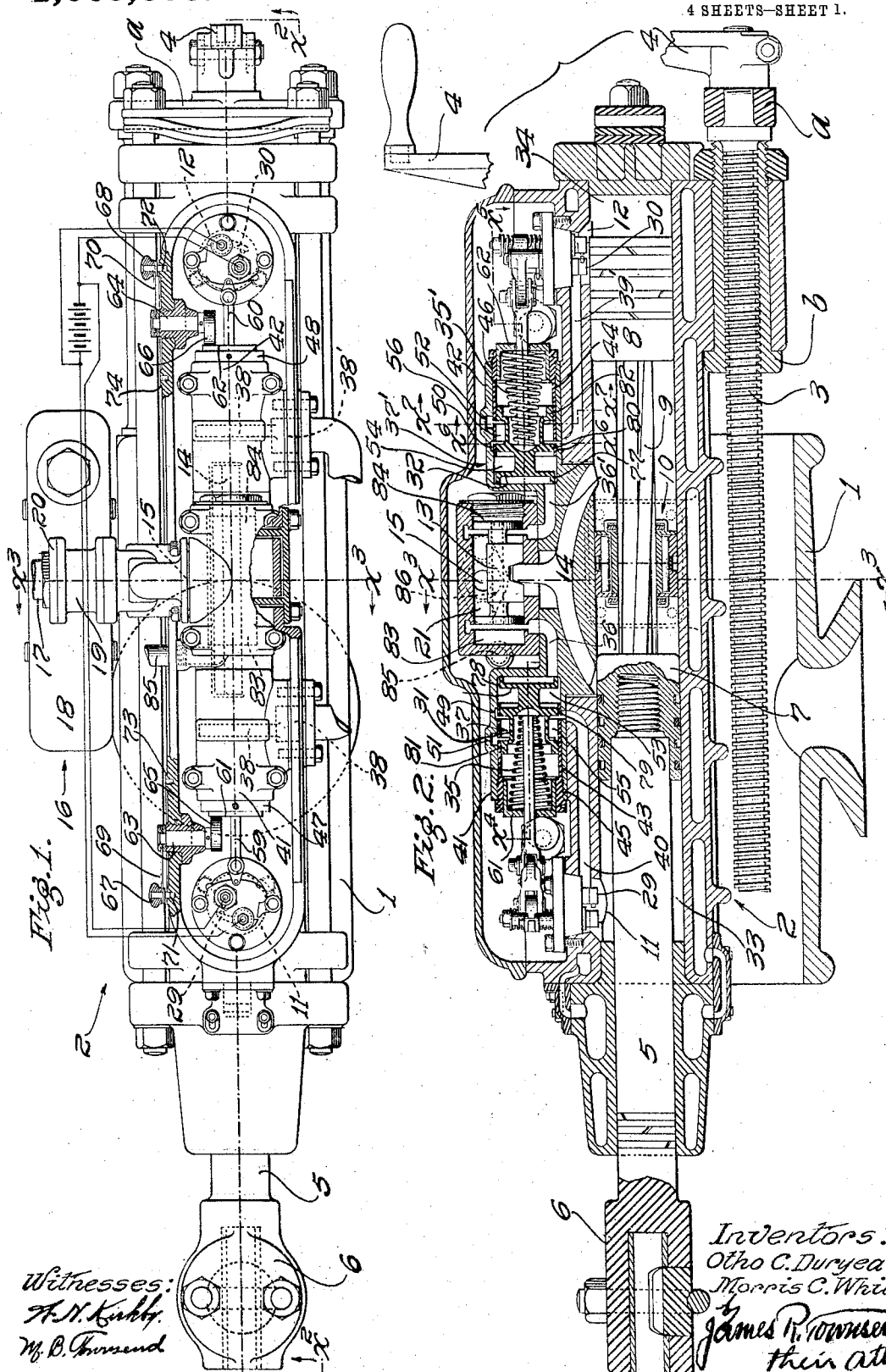
INTERNAL COMBUSTION TOOL.

APPLICATION FILED AUG. 6, 1908. RENEWED NOV. 4, 1912.

1,063,666.

Patented June 3, 1913.

4 SHEETS—SHEET 1.

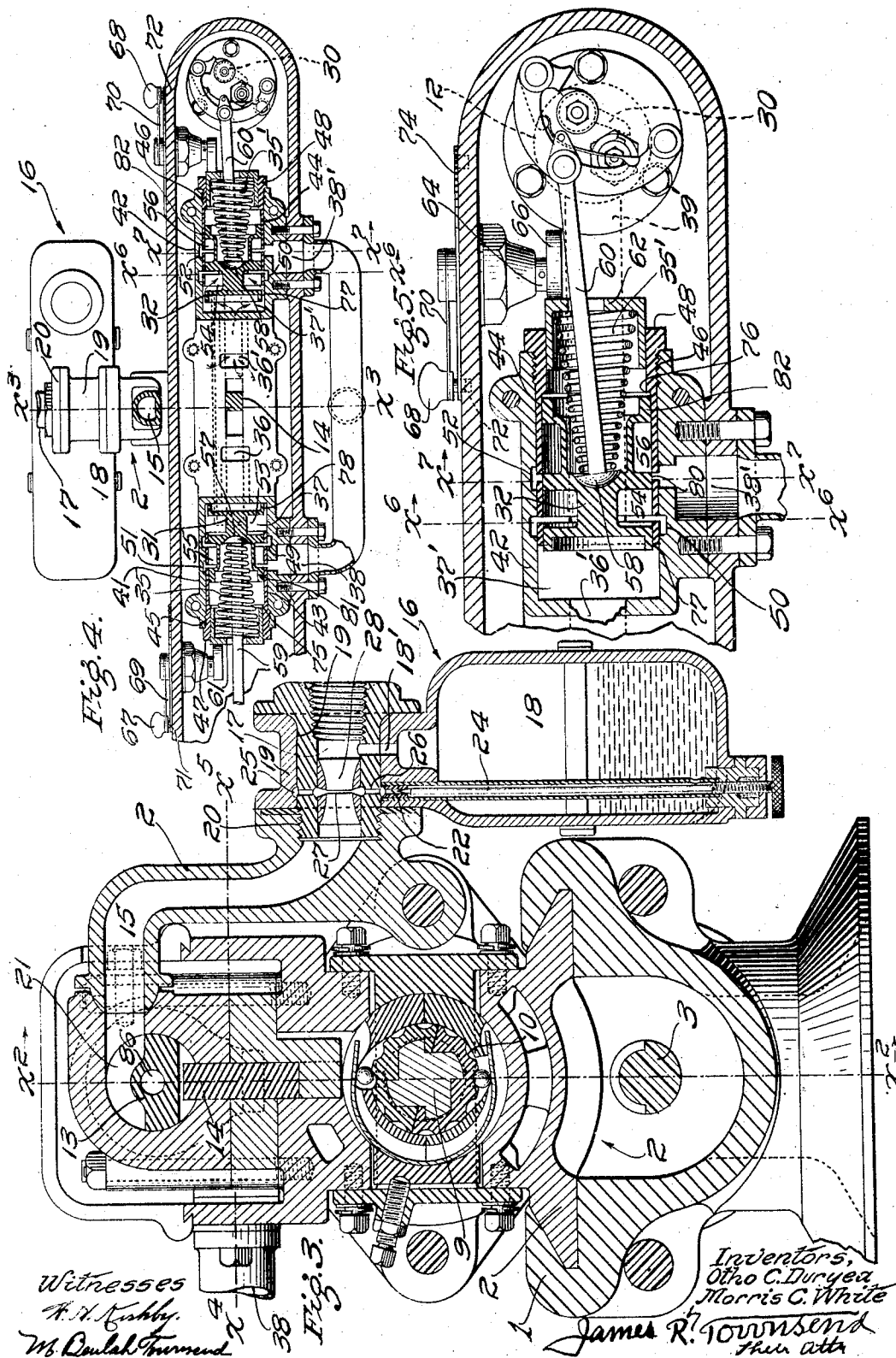


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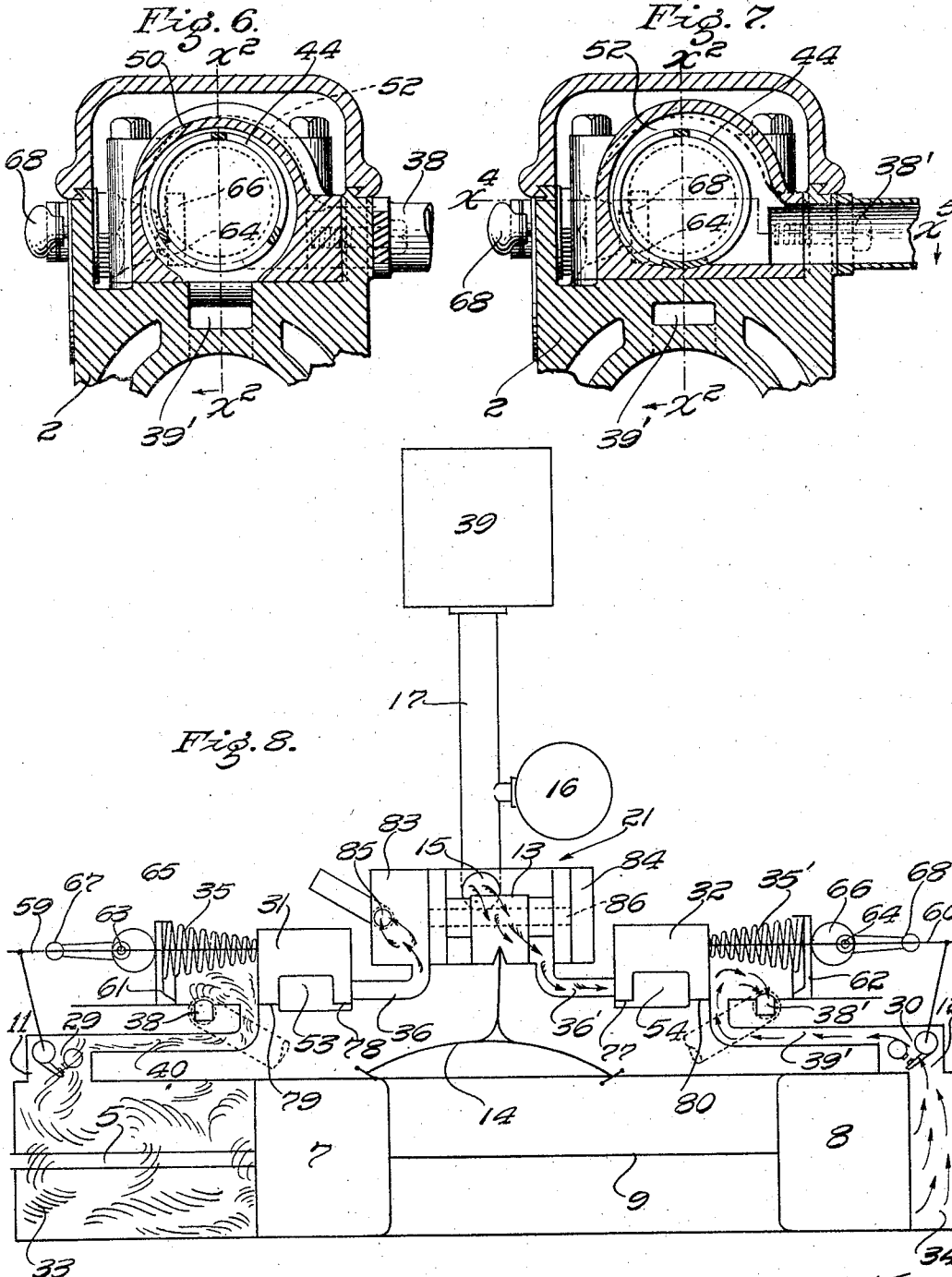
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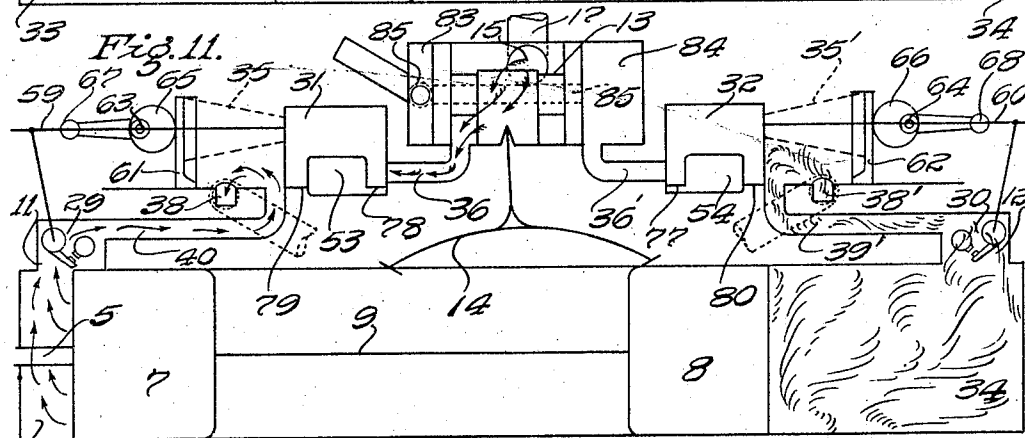
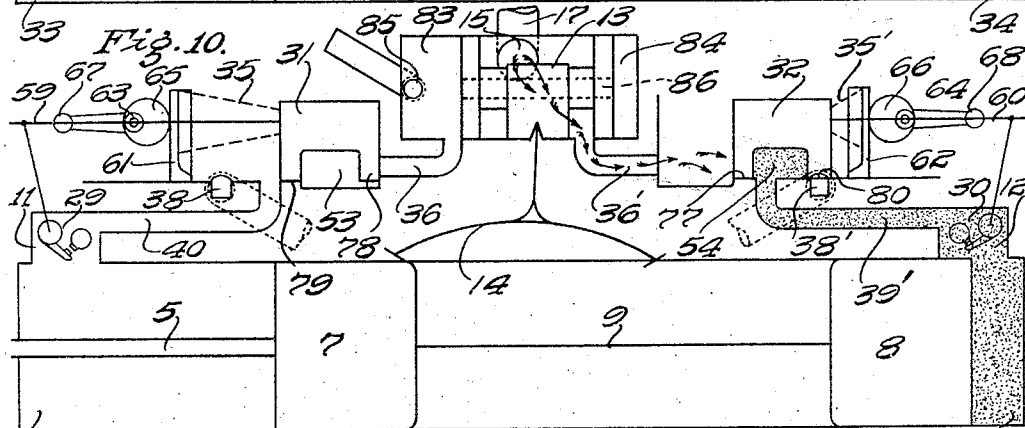
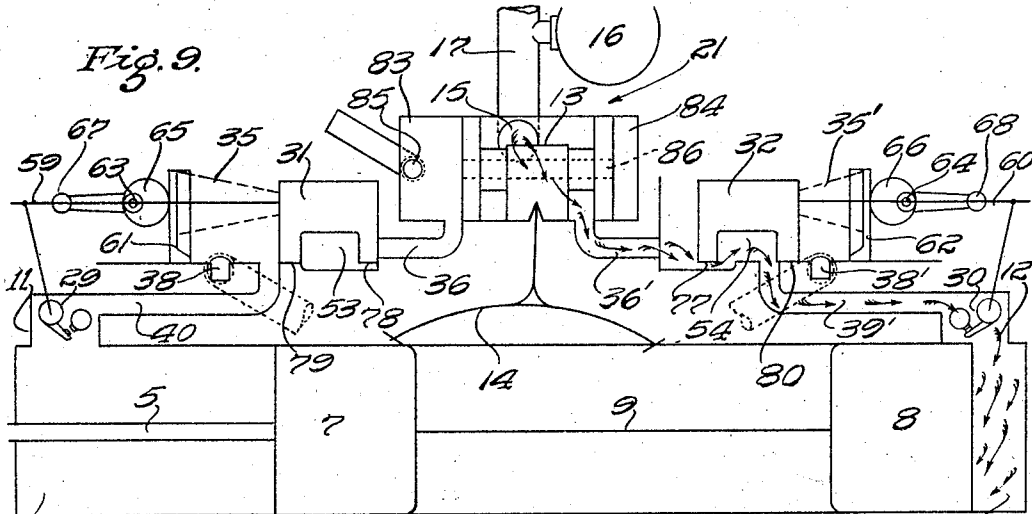
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UNITED STATES PATENT OFFICE.

OTHO C. DURYEA AND MORRIS C. WHITE, OF LOS ANGELES, CALIFORNIA, ASSIGNORS
OF ONE-TENTH TO JAMES R. TOWNSEND, OF LOS ANGELES, CALIFORNIA.

INTERNAL-COMBUSTION TOOL.

1,063,666.

Specification of Letters Patent.

Patented June 3, 1913.

Application filed August 6, 1908, Serial No. 447,316. Renewed November 4, 1912. Serial No. 729,468.

To all whom it may concern:

Be it known that we, OTHO CROMWELL DURYEA and MORRIS COLUMBUS WHITE, both citizens of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Internal-Combustion Tool, of which the following is a specification.

Our invention relates to improvement in the construction of internal-combustion rock-drills, hammers and other tools of the general nature which perform work through impact or pressure by power generated in the tool.

One of our objects is to provide an internal-combustion tool of an improved construction which renders it particularly easy to regulate at will the force of the blows of its work-performing member, as well as the force, if desired, with which said member is retracted between blows.

Another object is to provide an internal-combustion tool so constructed that it may be employed with great advantage and economy in connection with compressed air supplying apparatus of pneumatic drill, or other plants, and in place of the purely pneumatically-operated tools hitherto employed in this connection.

Still another object is to provide a tool, such as a drill or hammer, which may be worked as a pneumatic tool, by the force of air generated at a compressor, particularly during the initial operations, and then worked as an internal-combustion tool, requiring therefor air under a pressure and volume much less than is necessary for operating the device simply as a pneumatic tool.

The accompanying drawings illustrate the invention in one form of embodiment.

Figure 1 is a plan of a pneumatic tool adapted to be used as a rock-drill embodying the principles of our invention. Parts are broken to show the pressure-regulator. Fig. 2 is an axial section on line x^2 , Figs. 1, 3, 6 and 7. Fig. 3 is a transverse section on line x^3 , Figs. 1, 2 and 4. Fig. 4 is a broken plan section on plane indicated by x^4-x^5 , Figs. 2 and 3, to show the ports and the controlling-valve action. Fig. 5 is an enlarged detail of one of the pressure-regulator valves and of the igniters on the same plane as Fig. 4, showing a different position of parts. Fig. 6 is a section on line x^6 , in

Figs. 2, 4 and 5. Fig. 7 is a section on the line x^7 , in Figs. 2, 4 and 5. Figs. 8, 9, 10 and 11 are diagrammatic views showing the paths of the compressed air and explosive mixture, the automatic valves, the pressure-regulators, and the igniters, for the purpose of showing their changing positions and their coöperation.

The tool shown in the drawings is provided with a shell 1; cylinder 2 slidingly mounted thereon; feed-screw 3 connecting the cross-head a of the shell to the nut b of the cylinder; feed-handle 4; piston-rod 5; chuck 6 for holding the drill or work-performing member; piston-heads 7, 8, connected by a rifle-bar 9 working through a ratchet-clutch 10; duplicate inlet-ports 11, 12; spool-valve 13 to supply the same; tap-pet 14 operable by the piston-heads to operate said valve intermittently, and an air-port 15 to deliver air from a source of compressed air to the spool-valve. All these parts are similar to the parts of a common pneumatic tool.

16 designates fuel-supplying means introduced in the air-line 17 that supplies the spool-valve 13. The fuel-supplying means may be variously constructed. The form shown in the drawings is at present deemed preferable for general use. Air alone, entering the port 15 under a head of pressure necessarily provided in purely pneumatic rock-drill plants, will reciprocate the shaft 5 and perform the work of a pneumatic tool without interference from the additional features, hereinafter described, which we have provided for the purpose of converting the device into an internal-combustion tool. These additional features, as illustrated in the drawings, consist, briefly stated, in a gasoline supplier interposed in the pipeline, a sparker, or electric igniter, located adjacent to the end of each cylinder, and sparker-actuating regulator-valves interposed in passages extending between the main valve 13 and cylinder-ports 11 and 12. The regulator-valves are held normally closed, in the direction of the said main valve, by springs equipped with tensioning means under ready control of the operator. The pressure of the explosive mixture entering at the port 15 must, at all times in practice, exceed the resistance against opening movement of the regulator-valves. When, through the operation of the main

valve, the mixture is directed toward one of the cylinders, the fluid-pressure is first exerted against the respective regulator-valve to open the passage to the cylinder whereby the mixture enters the cylinder. When the back-pressure of the fluid in the cylinder exceeds the resistance of the regulator-valve spring, the said valve is given a further movement by the incoming fluid-pressure whereby it closes the passage to the cylinder, thereby trapping the charge in the cylinder. The cylinder exhaust-passage is also controlled by the said regulator-valve. In the normal position of the regulator-valve, to which it is pressed by its spring to close the cylinder-supply passage, it opens the exhaust-port, while in any position away from normal it closes the exhaust-port. In the movement of the regulator-valve from its position of opening the supply passage to the cylinder to that of trapping the mixture in the cylinder, it operates the sparker to ignite the trapped charge in the cylinder and produce an explosion. The force of the explosion in each instance in either cylinder depends upon the pressure of the charge in the cylinder at the time its sparker is operated. This pressure is governed by the respective regulator-valve spring, and means are provided whereby the tension of the spring may be varied by the operator, at will, to vary the force of the explosion. The force of each blow of the work-performing member and the power applied for its return is thus under the direct control of the operator.

18 is a receptacle provided with an eye 19 by which the receptacle is hung on a nipple 20 that is screwed into a part of the cylinder 2 to connect the compressed-air line 17 with the supply-port 15 leading to the chamber 21 of the spool-valve 13. The receptacle 18 is provided with an outlet 22 controlled by a vertical needle-valve 24, and leading through a channel 25 around the nipple 20 through ports 26 in said nipple 20 and ports 27 in bushings 28 having a constricted passage through which the air from the air-line 17 is introduced through the supply-port 15 into valve-chamber 21, thus to carry gas into said chamber along with the compressed air. The compressed air is admitted to the receptacle 18 through the port 18' to balance the pressure so that when the compressed air passes through the constricted opening 27 an atomizer is established to introduce the gas into the compressed air, said gas being derived from gasoline, or the like, in the receptacle 18.

29 and 30 are electrical igniters which may be of the ordinary make-and-break type, and are arranged in the ports 11 and 12 so that the sparking chambers will be scavenged and the explosive mixture will come in contact with the igniters and the

igniter-points will be surrounded by fresh explosive mixture at the time of ignition.

31 and 32 designate two pressure-regulating valves to control the ports 11 and 12 respectively, which supply the explosion-chambers 33 and 34. Springs 35, 35', normally hold the valves 31 and 32 in position to close the ports 11 and 12.

36, 36', are forward and rear ports controlled by the main spool-valve 13 and leading to the regulator valve chambers 37, 37', which communicate with the external air through exhaust-ports 38, 38' that are controlled by the pressure-regulating valves 31, 32.

Referring to Fig. 8, compressed air is coming from the air-compressor 39 through the air-line 17; the carbureter 16 is discharging gas into the compressed air, and the explosive mixture is passing through the port 15 to the main spool-valve chamber 21. An explosion has just taken place in the forward explosion-chamber 33, while the gas in said chamber was trapped by the pressure-regulating valve 31. The pistons 7 and 8 have moved backwardly, bringing the piston 8 into the rear end of the explosion-chamber 34. On the backward movement the piston 7 has moved the tappet 14 to shift the main spool-valve 13, and the exhaust is now passing from the explosion-chamber 34 through the rear port 12 and conduit 39', behind the regulator-valve 32, through the port 38'. The passage from the valve-chamber 21 to the forward port 36 is closed by the spool-valve 13, and the passage from the explosion-chamber 33 through the forward port 11 and conduit 40 to the port 36 is closed by the regulator-valve 31. The explosive mixture is passing through the port 15 toward the rear port 36', and is pressing against the forward end of the regulator-valve 32 to overcome the tension of the spring 35' behind said valve.

Referring now to Figs. 2, 4 and 5, the valve-chambers 37, 37', are bored from the outer ends of the castings 41 and 42, and cylinders 43 and 44 are fitted into these chambers from their outer ends, being screw-threaded at 45 and 46 to connect the cylinders to the castings. The enlarged end-ports 47, 48 of the cylinders bear against the ends of the castings or tubes 41, 42 to insure the proper positioning therein of the cylinders. The cylinders are shorter than the bores in the castings, so as to leave the inner ends of the valve-chambers 37, 37', enlarged. The ports 36, 36', lead to these enlarged ends. In boring the chambers in the castings 41 and 42, annular enlargements 49 and 50 are formed in position to be covered by the inner ends of the cylinders 43 and 44. These enlargements respectively communicate with the conduits 39' 139

and 40. Short distances outside of these enlargements 49 and 50 are similar enlargements 51 and 52 communicating with the exhaust ports 38 and 38'. Slots are cut through the cylinders to communicate with the enlargements 49, 50, 51 and 52. The regulating valves 31 and 32 fit operatively within the cylinders 43 and 44, said valves being of cylindrical form and reduced in diameter at two places to form two passages around each valve; viz.,—the passages 53, 54, to communicate through the slots with the enlargements 49 and 50 and the conduits 39' and 40; and the passages 55, 56, to communicate through the slots with the enlargements 51 and 52, and the exhaust-ports. The outer ends of the valves 31 and 32 are counterbored, there being hemispherical bearings 57 and 58 at the bottoms and centers of the counterbores to receive the hemispherical heads on the connecting-rods 59 and 60, operating the igniters 29 and 30. Caps 61 and 62 are slidingly mounted in the outer ends of the cylinders 43 and 44, there being openings through the heads of the caps to allow the connecting-rods to vibrate, and the expansive coil-springs 35 and 35' are inserted between the hemispherical heads upon the connecting-rods 59 and 60 and the caps 61 and 62; said caps serving as seats for the outer ends of the springs, and said heads serving as seats for the inner ends of the springs; the force of the springs being exerted to throw the regulator-valves inwardly, and said springs being flaring at their outer ends to provide room for the vibration of the connecting-rods 59 and 60. Short shafts 63 and 64 are mounted through one wall of the shell, and eccentrics 65 and 66 are fixed upon the inner ends of the shafts in position to engage the caps 61 and 62; and adjusting handles 67 and 68 are connected to the outer ends of the shafts by spring-arms 69 and 70 so that by operating the handles 67 and 68 the eccentrics 65 and 66 are operated to move the caps 61 and 62 inwardly to compress the springs or to allow the caps to move outwardly and the springs to expand. Pins 71 and 72 are carried by the handles 67 and 68 to engage seats in the index-plates 73 and 74 to hold the eccentrics in their adjusted positions. The outer ends of the bores in the cylinders 43 and 44 are reduced in size to form stops 75 and 76 to limit the outward motion of the regulating-valves.

In Fig. 9 the continued operation of the machine has progressed slightly from the positions shown in Fig. 8; the pressure of the explosive mixture against the regulating-valve 32 is overcoming the spring 35' and is moving said valve slightly so that the valve-face 77 between the opening 54 and the inner end of the valve is in the en-

larged inner end of the valve-chamber 37', thereby allowing the explosive mixture to pass around the valve-face 77 to the opening 54 and then to the conduit 39' through the port 12 to the chamber 34. At this time the valve-face 78 on the valve 31 has moved inwardly so that the valve closes the port 36 and the valve-face 79 is moved to a position inside of the conduit 40 so as to allow said conduit 40 to communicate with the exhaust-port 38. The valve-face 80 upon the valve 32 serves to close the connection between the conduit 39' and the exhaust-port 38'. The valve-faces 81 and 82 upon the opposite sides of the openings 55 and 56 from the valve-faces 79 and 80 serve to hold the exhaust from passing to the spring-chambers 35 and 35'. (See Figs. 4 and 5.) The valve-faces 77, 80 and 82 are peripheral faces left on making the passages 54 and 56; and likewise the valve-faces 78, 79 and 81 are left on making the passages 53 and 55.

Pockets 83 and 84 are formed at the ends of the valve-chamber 21, and the valve exhaust port 85 leading outwardly from the pocket 83 serves as a relief or exhaust port for the main valve 13; there being an opening 86 leading through the valve 13 to connect the pocket 84 to the pocket 83 so that the pressure from both ends of the valve exhausts through the valve exhaust port 85. When the valve 31 moves inwardly to release the exhaust from the explosion-chamber 33 and the main valve 13 moves backwardly, the compressed explosive mixture in the port 36 escapes through the pocket 83 to the valve-exhaust-port 85. The explosive mixture continues to flow into the explosion-chamber 34 until the valve-face 77 contacts with the cylinder 44, thereby shutting off the force of the air-compressor and trapping the gas in the explosion chamber, as shown in Fig. 10. This outward movement of the valve 32 operates the connecting-rod 60 to operate the igniter and cause the explosion. Then the piston 8 moves forwardly, hits the tappet 14, moving the main valve 13, thereby shutting off the air-pressure and allowing the valve 32 to move forwardly, thereby opening the exhaust, as shown in Fig. 11.

In practical operation the air-compressor 39 forces air through the air-line 17 past the carbureter, to the supply-port 15, and starts the machine as a pneumatic-tool. The carbureter introduces gas into the compressed air, thereby producing an explosive mixture that passes thence to the explosion chambers, and is trapped, ignited and exploded in rapid succession. The handles 67 and 68 are independently operable to regulate the force of each explosion chamber separately. The carbureter is adjustable to regulate the flow of gas to the air. Thus we have combined with a pneumatic tool, means

of introducing gas into the compressed air, means of trapping the gas in the explosion chambers, means for adjusting the pressure in each explosion chamber independent of the other, and means for igniting the gas in the explosion chambers; the tool being adapted for starting as easily as an air-drill and for continuous operation with the power of a gas engine. The fuel used may be gas made in a carbureter operated and controlled by the compressed air, or may be natural or domestic gas, or gas from any source of supply. Any suitable means for trapping the gas in the explosion chambers may be employed, and any suitable igniter may be employed. We prefer that the valves and igniter shall be controlled and operated by the compressed explosive mixture. We have also provided means for adjusting and regulating the flow of gas into the compressed air, and means for adjusting and regulating the flow of the compressed explosive mixture to the explosion chambers, so as to control the force of the strokes. This adjusting and regulating is effected manually, and may be varied as desired.

We have shown and described our invention as applied to a pneumatic rock-drill, but the same principles are applicable to a hammer operable like a steam-hammer and to various other tools employing one or more pistons and cylinders, one movable with relation to the other to operate a work-performing member.

Our invention may be applied to machines as now in use with air-compressors deriving their power from a steam-plant or from any other suitable source; but in new work an electric-motor and air-compressor may be substituted for the old systems so that in a new plant we will have a pneumatic tool, means for introducing gas to increase the power of the pneumatic tool, and a comparatively small gas or electric air-compressor furnishing compressed air direct to the tool.

It is obvious that the tool will start and operate from the compressed air alone. By the introduction of gas and by adjusting and regulating the gas, the power of a given machine may be increased many times, and to any desired extent within the range.

We claim:

1. In an internal-combustion power device, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having an inlet port and a passage communicating with said port, means for directing explosive fluid from the supplier intermittently into said passage, and a regulator-valve governing said port and exposed to pressure from said supplier in said passage to move when the pressure against it exceeds a predetermined limit to close said port.

2. In an internal-combustion power de-

vice, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having a port, a passage communicating with said port and an exhaust opening, means for directing explosive fluid from the supplier intermittently into said passage, and a regulator-valve normally closing said passage and opening communication between said port and exhaust and exposed to pressure from said supplier in said passage to be moved thereby to first close the exhaust and open said port to the supplier and then, by further movement, to close said port and trap the charge in the cylinder.

3. In an internal-combustion power device, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having an inlet port and a passage communicating with said port, means for directing explosive fluid from the supplier intermittently into said passage, and a spring-pressed regulator-valve governing said port and exposed to pressure from said supplier in said passage to move when the pressure against it exceeds the resistance of its spring to close said port and trap the charge in the cylinder.

4. In an internal-combustion power device, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having a port, a passage communicating with said port and an exhaust opening, means for directing explosive fluid from the supplier intermittently into said passage, and a spring-pressed regulator-valve normally closing said passage and opening communication between said port and exhaust, and exposed to pressure from said supplier in said passage to be moved thereby against the resistance of its spring to first close the exhaust and open said port to the supplier and then, by further movement, to close said port and trap the charge in the cylinder.

5. In an internal-combustion power device, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having a port, a passage communicating with said port and an exhaust opening, means for directing explosive fluid from the supplier intermittently into said passage, and a spring-pressed regulator-valve normally closing said passage and opening communication between said port and exhaust and exposed to pressure from said supplier in said passage to be moved thereby to first close the exhaust and open said port to the supplier, and then, by further movement, to close said port and trap the charge in the cylinder, and means for changing the tension of said spring to vary the pressure of the explosive charge in the cylinder, for the purpose set forth.

6. In an internal-combustion power device, the combination with a cylinder having an inlet passage and an exhaust-port, a pis-

ton in the cylinder, a supplier for explosive fluid under pressure, a charge-igniter in the cylinder, and intermittently-actuated means for directing the fluid from the supplier through said passage to the cylinder, of regulator-valve mechanism interposed in said passage in the path of said fluid to the cylinder governing the opening and closing of said passage and operatively connected with said igniter to actuate the same and operating under pressure from the supplier when the same is directed to said passage and after the charge has entered the cylinder to close said passage and actuate the igniter.

7. In an internal-combustion power device, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having an inlet port and a passage communicating with said port, means for directing explosive fluid from the supplier intermittently into said passage, an igniter, a regulator-valve, operatively connected with the igniter, governing said port and exposed to pressure from said supplier in said passage to move when the pressure against it exceeds a predetermined limit to close said port and actuate the igniter.

8. In an internal-combustion power device, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having a port, a passage communicating with said port and an exhaust opening, a charge-igniter in the cylinder, means for directing explosive fluid from the supplier intermittently into said passage, and a regulator-valve, operatively connected with the igniter, normally closing said passage and

opening communication between said port and exhaust, and exposed to pressure from said supplier in said passage to be moved thereby to first close the exhaust and open said port to the supplier, and then, by further movement, close said port, to trap the charge in the cylinder, and actuate the igniter.

9. In an internal-combustion device, the combination of a supplier for explosive fluid under pressure, a piston-cylinder having a port, a passage communicating with said port and an exhaust opening, a charge-igniter in the cylinder, means for directing explosive fluid from the supplier intermittently into said passage, a spring-pressed regulator-valve, operatively connected with the igniter, normally closing said passage and opening communication between said port and exhaust, and exposed to pressure from said supplier in said passage to be moved thereby against the resistance of its spring, to first close the exhaust and open said port to the supplier, and then, by further movement, close said port, to trap the charge in the cylinder, and actuate the igniter, and means for changing the tension of said spring.

In testimony whereof, we have hereunto set our hands at Los Angeles, California, this 1st day of August, 1908.

OTHO C. DURYEA.
MORRIS C. WHITE.

In presence of—

JAMES R. TOWNSEND,
W. BEULAH TOWNSEND.