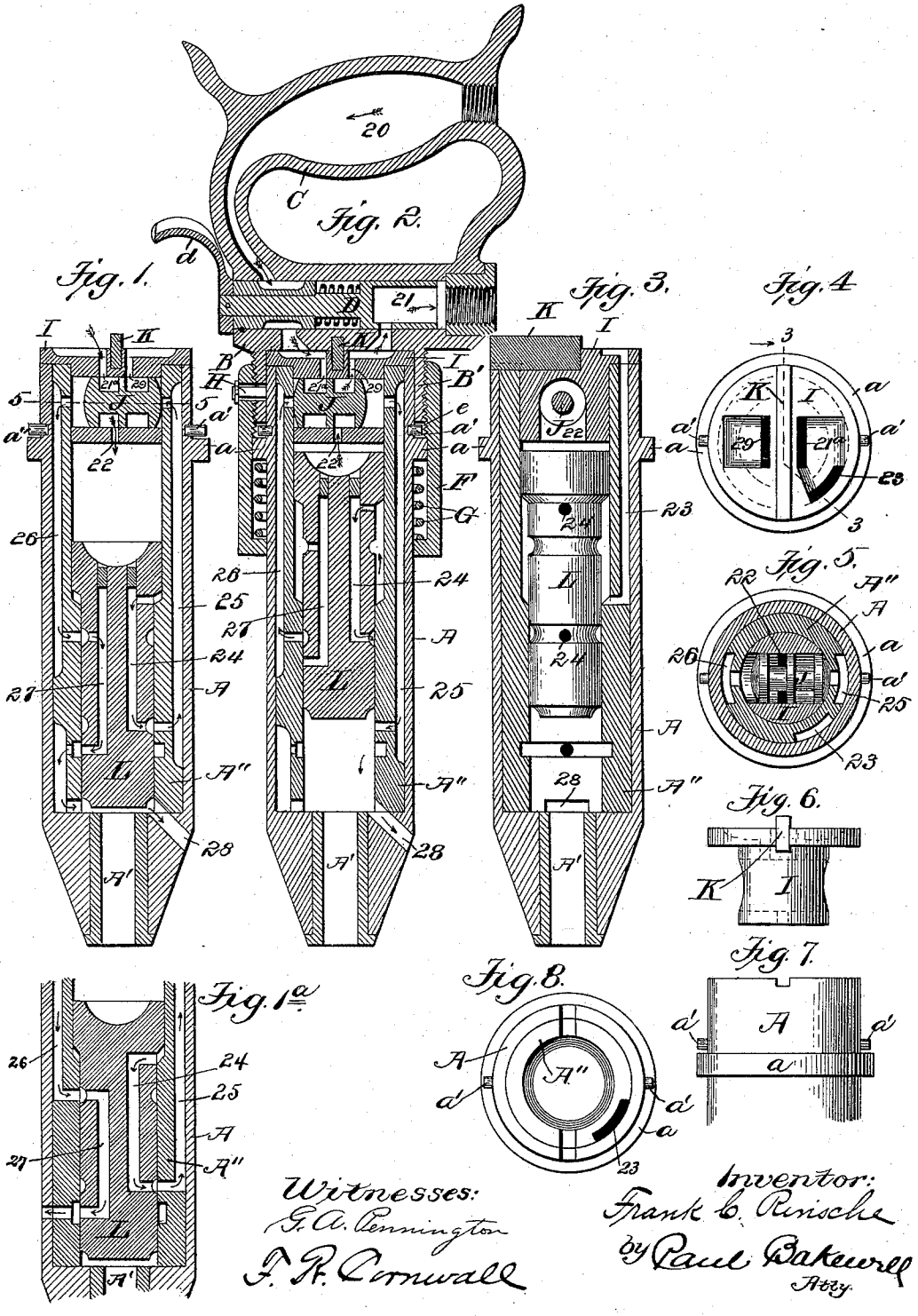
(No Model.) 2 Sheets—Sheet 1.

F. C. RINSCHE.

ENGINE.

No. 567,725. Patented Sept. 15, 1896.



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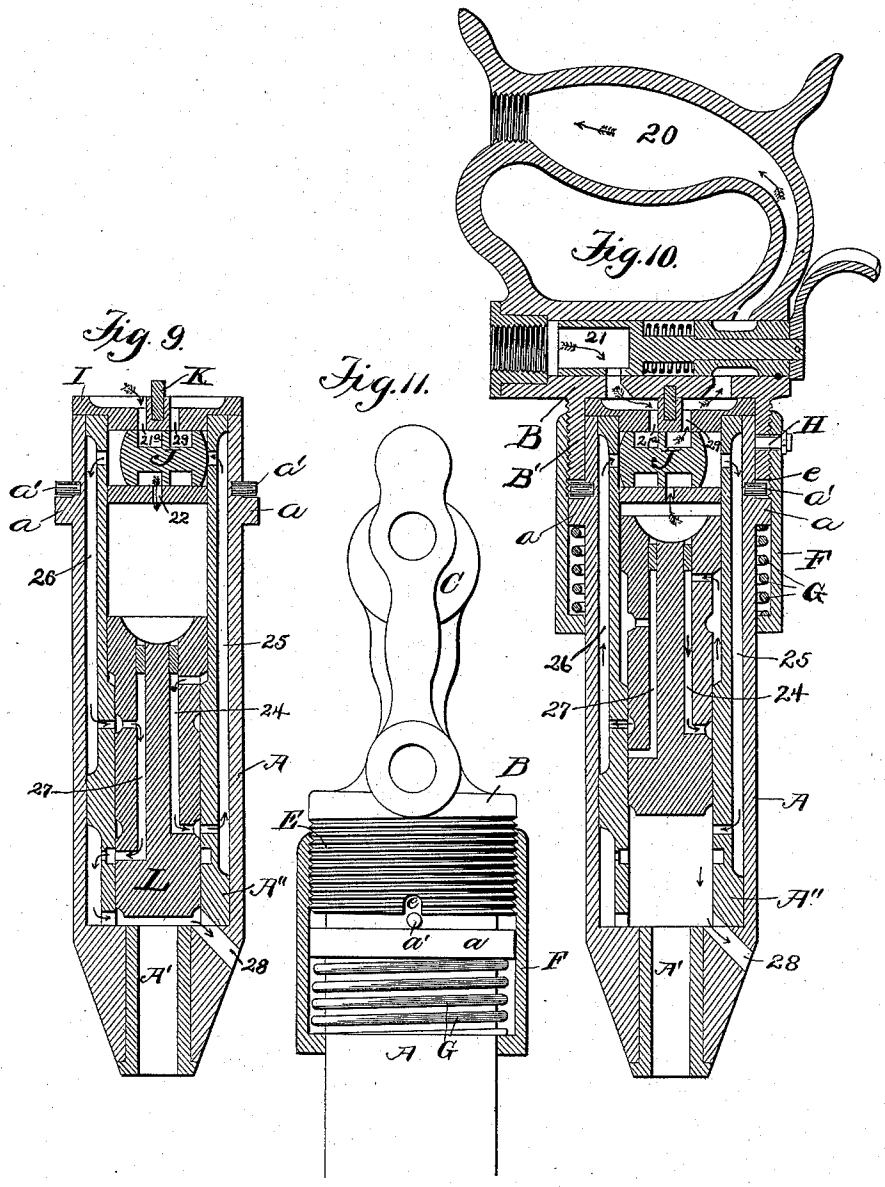

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UNITED STATES PATENT OFFICE.

FRANK C. RINSCHE, OF ST. LOUIS, MISSOURI, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE CHOUTEAU MANUFACTURING COMPANY, OF MISSOURI.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 567,725, dated September 15, 1896.

Application filed April 4, 1896. Serial No. 586,250. (No model.)

To all whom it may concern:

Be it known that I, FRANK C. RINSCHE, a citizen of the United States, residing at the city of St. Louis, State of Missouri, have invented a certain new and useful Improvement in Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, wherein—

Figure 1 is a longitudinal sectional view showing my improved engine, the piston being in its forward position and the handle and its associate parts being omitted. Fig. 1ª is a modified form of valve-exhaust. Fig. 2 is a similar view showing the piston and valve in a different position. Fig. 3 is a longitudinal sectional view taken at right angles to the view shown in Fig. 1, or on line 3 3, Fig. 4. Fig. 4 is a rear end view of the cylinder with the auxiliary cylinder-head in position. Fig. 5 is a cross-sectional view on the line 5 5, Fig. 1. Fig. 6 is a side elevational view of the auxiliary cylinder-head or valve-block. Fig. 7 is a fragmentary view in elevation of the rear end of the cylinder, the auxiliary cylinder-head or valve-block not being in position. Fig. 8 is a rear end view of the cylinder and its sleeve, the auxiliary cylinder-head or valve-block being omitted. Fig. 9 is a view similar to Fig. 1, showing, by arrows, the action of the motive fluid when the piston is delivering a different kind of blow than when the motive fluid acts as shown by the arrows in Fig. 1. Fig. 10 is a view similar to Fig. 9 with the piston and valve in a different position, also showing the handle in place. Fig. 11 is a detail view in side elevation showing the collar or coupling-sleeve in section and the manner of rotating the handle or cylinder relative to each other.

This invention relates to a new and useful improvement in direct-acting engines of that class which are known as "pneumatic hand-tools." The engine is adapted to be run by compressed air as a motive fluid, the piston delivering impacting-blows upon the end of a chisel or tool-shank arranged in the front end of the cylinder. The motive fluid is supplied to the engine by means of a flexible tube connected to some suitable source of supply. Engines of this class generally have present in their construction a cylinder, piston, and controlling-valve for the piston, although in some constructions this latter is absent and the piston is self-controlled. Sometimes these engines also have a handle, by which they may be more easily manipulated, and a throttle-valve for controlling the supply of motive fluid or for choking the exhaust. In controlling the supply of motive fluid or choking the exhaust the speed of the piston is controlled, and in all engines with which I am familiar this control of the speed of the piston also affects the strength or force of the piston-blows by making them lighter or weaker as the piston reciprocates more slowly. It is desirable in some work which an engine of this class is designed to perform that the piston be so controlled that it will run slow, but deliver a blow of full strength. By this I mean that the piston will deliver blows of full strength, intervals of time intervening between each blow, the length of these intervals of time being controlled by the operator. It is also desirable and advantageous in this connection that such blows of different kinds as I have described be delivered from one engine.

The object of this invention is to construct such an engine in which the piston will strike such blows.

Another object is to construct an engine in which the blows of the piston at the front end of the cylinder are cushioned, to relieve the operator of the shock or jar without detracting from the effectiveness of the blows upon the chisel.

Other objects in view are simplicity in construction, effectiveness, compactness, and economy in manufacture.

With these objects in view the invention consists, first, in constructing an engine which, by changing the position of the inlet and exhaust passages relative to the cylinder and piston, the control of one of such passage will cause the piston to deliver blows of different kinds, as above described; second, in the construction and arrangement of the handle or cylinder-head and the cylinder, whereby their relative positions may be changed to effect such blows of different kinds by the control of the inlet or exhaust passages; third, in the

novel construction of the handle or cylinder-head, the cylinder, and their connecting parts, whereby such changes may be effected without dissembling the tool; fourth, in interposing means between the handle or cylinder-head and the cylinder, whereby the shock or jar communicated to the cylinder upon the forward stroke of the piston is absorbed and not transmitted to the operator; fifth, in utilizing this absorbing medium as a means for holding the handle or cylinder-head and cylinder in their proper relative positions to effect the different kinds of strokes of the piston when the engine is controlled; sixth, in providing means to control the exhaust and admission of the motive fluid to and from the piston independently of the exhaust of the piston-controlling valve; seventh, in the novel port arrangements of the cylinder and piston, and, eighth, the novel construction, arrangement, and combination of the several parts, all as will hereinafter be described, and afterward pointed out in the claims.

In the drawings I have shown an engine in which are incorporated usual and well-known constructions, the details of which I do not claim as new; nor do I desire to be confined to the exact construction shown, for it is obvious that there are other forms and equivalents which could be utilized with equal effect without in the least departing from the nature and spirit of my invention. The form of engine shown in the drawings and its details of construction have been found to answer the purposes for which they are designed and will serve to illustrate my invention.

In the drawings, A indicates a cylinder, which is formed with the usual tool-opening A′ in its front end, for the reception of a chisel or like tool, upon which the piston delivers impacting-blows.

B indicates a handle-base or cylinder-head, from which extends a handle C, which handle is formed hollow, which hollow I will term a "passage" 20, the outer terminus of said passage ending in a threaded opening, in which is adapted to be fitted a hose-nipple, to which a supply-pipe (not shown) is connected, while the inner terminus of said passage is located, I will say, to avoid confusion, to one side of the cylinder-head.

D indicates a valve (shown in the drawings as a rotary plug-valve) arranged transversely the handle-base or cylinder-head, said valve being partially rotated by a suitable operating-handle *d*, to control a passage 21, whose outer end is threaded and adapted to receive a hose-nipple, to which a supply-pipe (not shown) is connected, while the inner terminus of said port is located, I will say, to avoid confusion, to one side of the cylinder-head and opposite the inner terminus of passage 20.

Extending forwardly from the handle-base B is a threaded flange B″, which embraces the rear end of the cylinder A, and is adapted to terminate short of a flange *a*, formed on said cylinder near its rear end.

F indicates a collar or coupling-sleeve, which is threaded upon flange E, the forward end of said collar being formed with an inturned flange, which confines the spring G therebetween, and the cylinder-flange *a*. A suitable locking device (shown in the drawings as a spring-pressed pin H) is arranged to coöperate with the collar F and flange E, for the purpose of preventing rotary movement between said parts, and also to permit adjustment of the collar, whereby the tension of spring G may be regulated.

To simplify the construction and reduce the cost of manufacture, the cylinder A is made with a sleeve A″, between which and the cylinder proper the various "cylinder-ports," as they are called, are formed, preferably, by grooving the outer periphery of the sleeve and forming openings through the same. This sleeve may be considered as part of the cylinder, because the ports and openings therein could be bored if the cylinder were made in one piece.

The rear end of the cylinder is closed by an end-closing plate or auxiliary cylinder-head I, which is formed with a valve-block extension, in which is located the piston-controlling valve J. The upper face of this auxiliary cylinder-head is formed with a transversely-disposed extension K, preferably formed by securing a bar in a groove formed through said auxiliary cylinder-head. This extension or bar K is adapted to fit into a transverse groove in the inner face of the handle-base B, and when said "bar," as I will call it, is seated home it forms a tight joint with the groove and it also forms a division-wall between the passages 20 and 21, at the same time preventing the handle-base and cylinder from rotating independently of each other. As shown in Figs. 6 and 7, bar K also extends in front of the rear lateral flange of the auxiliary cylinder-head or valve-block and fits into grooves across the rear end of the cylinder and its sleeve to prevent rotation or displacement of said auxiliary cylinder-head relative to those parts. It will be seen from the above that when the piston strikes the forward end of the cylinder and a tool-shank is not present to receive the blow any shock or jar of the cylinder will be in a forward direction, which will compress the spring G and save the operator. The bar K fitting up into a groove in the handle-base will move forward in its seat, but not a sufficient distance to displace the same, and thus the fluid from either passages 20 or 21 is prevented from blowing through. On the upstroke of the piston spring G will return the cylinder and handle-base to their normal positions, and the ports are so designed and arranged that the piston will be cushioned on its rear stroke, whereby the "vibration" of the engine, as it is known, is reduced to a minimum.

To effect a change in the blows of the piston upon the control of the engine, it is necessary to transpose the position or location of the passages 20 and 21 relative to the side of the bar K to or from which they lead, that is, if the passage 20 had been used as an inlet-passage and the passage 21 as an exhaust-passage for the piston, as shown in Figs. 1 and 2, the inlet-passage would be at the left of bar K and the exhaust-passage at the right of bar K. This relation would, upon the control of the exhaust, cause the piston to deliver a strong blow under full pressure, said blows being delivered at intervals. To do this—that is, change the passage 20 to exhaust from the right side of bar K while passage 21 admits motive fluid to the left of bar K, whereby the control of the motive fluid would cause the piston to deliver a light blow—the cylinder is pulled forward relative to the handle, compressing spring G until the bar K is out of its seat in the handle-base. Either the handle or the cylinder may be rotated relative to each other to effect a transposition of the passages 20 and 21, and upon reaching a position of half a revolution relative to each other the bar K will have been turned end for end and register with its groove in the handle-base. Spring G will now force the parts together, preventing further rotation until the above operation is repeated. Of course, if the parts were held apart so as to prevent the bar K from entering its groove, the rotating of the parts relative to each other may be continued indefinitely, but the object in view in this construction is that the parts may be separated and rotated in either direction relative to each other, and upon being rotated one-half of a rotation they shall be automatically restored to their normal operative position. Another way to accomplish the same result, except in so far as the bar K acts as a division-wall between the passages 20 and 21, is to notch or recess the flange E at its front edge, as indicated at *e*, into which notches *e* plugs or projections *a'*, extending from the cylinder, are adapted to enter and prevent the handle and the cylinder from rotating relative to each other.

Valve J is a three-headed valve, and preferably reciprocates in a direction at right angles to the stroke of the piston.

The cylinder is formed with two different diameters, in which operates the piston L. That part of the piston which fits into the larger bore I term the "head" in contradistinction to the body portion of smaller diameter, which I shall term the "body."

I will now describe the port arrangements, but before entering into the same it will be well to say that there is a constant pressure in front of the head of the piston tending to force it to the rear, and that when pressure is admitted above the piston the increase of area will force the piston forwardly against the pressure first mentioned and cause the same to deliver its blow at the front end of the cylinder. I will also say, further, that the supply of motive fluid is designed to pass through either passage 20 or 21 to effect the different blows above described.

In Figs. 1 and 2 the parts are so arranged that the valve D controls the exhaust, and the supply of motive fluid enters through passage 20. By controlling the exhaust, such as by rotating valve D to choke the same, the piston will move to the rear at a slow speed, but the forward stroke of the piston will be unretarded, so that the construction illustrated in these two figures may be said to show an engine whose control causes the piston to deliver blows at intervals whose length is under the control of the operator, said blows being of full strength. The supply of motive fluid entering through passage 20 will pass into port 21^a in the auxiliary cylinder-head or valve-block, where it is controlled by valve J. Assuming the valve to be in the position shown in Fig. 1, the motive fluid will pass through port 21^a and fill the space behind the piston, forcing the same forward. The auxiliary cylinder-head is recessed at its top, as shown in Fig. 4, and the live motive fluid is also admitted through port 23 in front of the head of the piston, as shown in Fig. 3, where it exerts a constant pressure. The piston is formed with a port 24, whose rear end is constantly open to the pressure in front of the piston-head, and upon the piston reaching the end of its forward stroke the front end of port 24 registers with a port 25, whose rear end terminates to one side of the valve J, and delivers the live motive fluid to that end of the valve and throws the same to the position shown in Fig. 2. At the same time that port 24 registers with port 25 to accomplish the throwing of the valve, the fluid at the other end of the valve is exhausted through port 26 in the cylinder, port 27 in the piston, whose rear end registers with the front terminus of port 26, and out through an opening 28 formed in the cylinder. The construction shown in the drawings of returning this valve-exhaust through another cylinder-port and beneath the piston, whence it passes out of the port 28, is not essential, as the exhaust could be carried out as shown by the view in Fig. 1^a. The valve having been thrown from the position shown in Fig. 1 to the position shown in Fig. 2, the central head of the valve will have closed the port 22, which will prevent the motive fluid from passing behind the piston. The pressure now in front of the head of the piston will assert itself and force the same to the rear, causing the fluid behind the piston to exhaust itself through the ports 22, 29, and passage 21. When the piston is near the end of its rear stroke, port 24 registers with port 26, which will admit the motive fluid to the end of the valve, causing it to be thrown from the position shown in Fig. 2 to the position shown in Fig. 1. At the same time, or just before the port 24 registers with port 26, the front end of the body

of the piston uncovers the front end of port 25 and permits the fluid at the end of the valve from which the port 25 leads to exhaust. The body of the piston in line with the rear terminus of port 27 and in line with the front terminus of port 24 is grooved circumferentially, so that no matter in what position the piston will be the ports will aline with their respective coöperating ports. The cylinder is also preferably grooved to coöperate with the front end of port 27 for the same purpose. It will be noted that the piston has a constant pressure, tending to force it to the rear, and an intermittent pressure controlled by the valve J, which forces the piston forwardly by reason of the excess area of the rear end of the piston over the slight shoulder forming the head, against which the constant pressure exerts itself. It will be further noted that the control of the valve, that is, the admission and exhaust of the fluid at its ends, is dependent entirely upon the piston, and although valve D may be turned to choke the exhaust, the piston-valve will still be thrown independently thereof. This choking of the exhaust of the piston by valve D retards its rear stroke, but when the valve is thrown to admit the motive fluid behind the piston the piston descends with its full force. Therefore the control of the engine illustrated in Figs. 1 and 2 will decrease the speed of the piston to the rear, causing it to run slower, but permit it to deliver a blow of full strength on its forward stroke.

In Figs. 9 and 10 the parts are so arranged that the valve D controls the supply of motive fluid entering through passage 21, and there is an uninterrupted exhaust from the piston through passage 20. In this construction the supply-pipe is attached so as to feed the supply of motive fluid into passage 21, while in the construction shown in Figs. 1 and 2 the motive fluid is supplied through passage 20. By controlling the supply of motive fluid, such as by rotating valve D to throttle the same, the piston will move in both directions at a slow speed, and on account of the reduced pressure entering the engine the blows will necessarily be light. The supply of motive fluid entering through passage 21 will pass into port 21^a in the auxiliary cylinder-head or valve-block, where it is controlled by the valve J. Assuming the valve to be in position shown in Fig. 9, the motive fluid will pass through port 22 and fill the space behind the piston, forcing the same forward against its constant pressure in front of the piston-head. When the piston reaches the end of its forward stroke, port 24 will register with port 25 and direct the live motive fluid against the valve J, so as to throw the same. At the same time the fluid at the other end of the valve is exhausted through the port 26 in the cylinder, port 27 in the piston, and opening 28 formed in the cylinder. The valve having been thrown from the position shown in Fig. 9 to the position shown in Fig. 10, the central head of the valve will shut off the motive fluid from behind the piston, and the pressure in front of the head of the piston will assert itself and force the same to the rear, causing the piston to exhaust itself uninterruptedly through the ports 22 29 and passage 20. When the piston is near the end of its rear stroke, port 24 registers with port 26, causing the valve to be thrown from the position shown in Fig. 10 to the position shown in Fig. 9. At the same time, or just before port 24 registers with port 26, the front end of the body of the piston uncovers the front terminus of port 25 and exhausts the fluid at the end of the valve from which the port 25 leads, permitting said exhaust to pass out through the opening 28.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an engine, the combination with the cylinder, of a piston, ports in said cylinder and piston, a piston-controlling valve for admitting and exhausting the motive fluid from the rear end of the piston-chamber, and means for choking the exhaust of the rear end of the piston-chamber as it passes beyond the valve, whereby, the piston may be made to deliver blows of full strength at intervals, the length of said intervals being controlled by the operator in the regulation of the exhaust; substantially as described.

2. In an engine, the combination with the cylinder, of a piston, ports in said cylinder and piston, passages leading to and from the rear end of the piston-chamber, a valve for controlling said passages, whereby, the motive fluid is admitted and exhausted from behind the piston, and means for controlling one of said passages, said means being independent of the piston-controlling valve; substantially as described.

3. In an engine, the combination with the cylinder, of a differential piston operating therein, a controlling-valve for said piston, two passages leading to said valve-chamber, one of which is capable of being controlled, and a passage connecting said valve-chamber to the rear end of the piston-chamber, whereby, when said controlled passage is used as an inlet, the pressure may be reduced, and when said controlled passage is used as an exhaust the piston will deliver blows of full strength on its forward movement, the rearward movement of the piston being capable of being controlled by choking such exhaust-passage; substantially as described.

4. In an engine, the combination with the cylinder and its piston, of a handle-base or cylinder-head through which are formed the supply inlet and exhaust, said handle-base being capable of rotation relative to the cylinder for the purpose of changing the location of the supply-inlet and exhaust; substantially as described.

5. In an engine, the combination with the cylinder and its piston, of a handle-base or

cylinder-head through which are formed two passages, and a valve for controlling one of said passages, whereby, when said controlled passage is used as a supply-inlet, the motive fluid may be throttled and when said passage is used as an exhaust, the exhaust may be choked, to control the engine; substantially as described.

6. In an engine, the combination with the cylinder and its piston, of a handle-base or cylinder-head through which are formed two passages, a valve for controlling one of said passages, said cylinder-head being capable of rotation relative to the cylinder, whereby the controlled port may be used either as a supply-inlet or as an exhaust; substantially as described.

7. In an engine, the combination with the cylinder and its piston, of a handle-base or cylinder-head through which are formed two passages, a valve for controlling one of said passages, said cylinder-head being adapted to be rotated relative to the cylinder, whereby the controlled passage may be used either as supply-inlet, or as an exhaust, and means for retaining the cylinder-head in such position; substantially as described.

8. In an engine, the combination with the cylinder and its piston, of a handle-base or cylinder-head through which are formed a supply-inlet and exhaust-passage, said cylinder-head being capable of rotation relative to the cylinder for the purpose of transposing or interchanging the passages in the cylinder-head relative to the cylinder, a valve for controlling one of said passages, whereby, upon the change thereof from a supply-inlet to an exhaust-passage, upon the control of the engine, the piston delivers blows of different kinds, and yielding means for retaining the cylinder-head in an operative position substantially as described.

9. The combination with the cylinder, of a handle-base or cylinder-head which is yieldingly held thereupon, said parts being capable of rotation relative to each other; substantially as described.

10. The combination with the cylinder, of a handle-base or cylinder-head which is yieldingly held thereagainst, said parts being capable of rotation relative to each other, and means for preventing said parts from rotating; substantially as described.

11. The combination with the cylinder, having a flange formed thereon near its rear end, a spring which surrounds said cylinder, in front of said flange, a handle-base or cylinder-head mounted at the rear end of the cylinder, and an extension on said handle-base, which incloses said spring, the front end of the spring bearing against said extension, while the rear end of the spring bears against the cylinder-flange, whereby, the jar occasioned by the forward stroke of the piston is cushioned or absorbed before it is transmitted to the operator; substantially as described.

12. The combination with the cylinder, of a handle-base which is yieldingly held thereagainst, and an auxiliary cylinder-head interposed between the handle-base and cylinder; substantially as described.

13. The combination with the cylinder, of a handle-base, an auxiliary cylinder-head interposed between the handle-base and the cylinder, and a projection on said auxiliary cylinder-head which is adapted to coöperate with a groove in the handle-base; substantially as described.

14. The combination with the cylinder, of a handle-base which is yieldingly held thereagainst, an auxiliary cylinder-head, and a tranversely-disposed projection on said auxiliary cylinder which is adapted to coöperate with a transverse groove in the handle-base; substantially as described.

15. The combination with the cylinder formed with the flange near its rear end, a handle-base, a collar or coupling-sleeve which engages said handle-base, and is formed with an inturned flange in front of the cylinder-flange, and a spring interposed between the said flanges; substantially as described.

16. In an engine, the combination with the cylinder and its piston, of a handle-base or cylinder-head through which are formed a supply-inlet and exhaust-passage, said handle-base being yieldingly held against the cylinder and being capable of rotation relative to said cylinder, an auxiliary cylinder-head interposed between the base and cylinder, and a transversely-disposed projection on said auxiliary cylinder which coöperates with a groove in the handle-base for the purpose of preventing rotation between the parts, which projection also serves as a division-wall between the supply-inlet and exhaust-passage; substantially as described.

17. The combination with the cylinder, of a valve-lock at its rear end, a three-headed valve in said block, ports 21^a, 22, and 29, which coöperate with said valve to supply the motive fluid and exhaust the same from behind the piston, and a handle-base or cylinder-head having a valve which is adapted to control the inlet or exhaust of said valve-chamber at the will of the operator; substantially as described.

18. The combination with the cylinder having a flange thereon near its rear end, a cylinder-head or handle-base at the rear end of the cylinder, a collar or coupling-sleeve which engages said cylinder-head, said collar or coupling-sleeve having an inturned flange in advance of the cylinder-flange, a spring interposed between the said flanges, and a lock which coöperates between the collar and handle-base for the purpose of locking such parts against independent rotation, and also permitting the collar to be adjusted to regulate the tension of the spring; substantially as described.

19. The combination with the cylinder hav-

ing a flange near its rear end, of a handle-base or cylinder-head which is formed with a flange B′ to embrace the rear end of the cylinder, an auxiliary cylinder-head at the rear end of the cylinder, which auxiliary cylinder-head is formed with a valve-block extension, and a collar or coupling-sleeve which coöperates with the flange B′ and the cylinder-flange for the purpose of holding the parts together; substantially as described.

20. The combination with the cylinder, of a handle-base or cylinder-head which is yieldingly held thereagainst, which cushions the shock or jar occasioned by the forward stroke of the piston, a supply-inlet and exhaust-passage formed through said cylinder-head, a valve for one of said passages, an auxiliary cylinder-head interposed between the handle-base and cylinder, and a transversely-disposed projection on said last-named cylinder-head which coöperates with a groove in the handle-base to prevent rotation between the parts, and which also serves as a division-wall between the supply-inlet and exhaust, to prevent blowing through, when the forward stroke of the piston is being cushioned; substantially as described.

21. The combination with a cylinder and its piston, of a handle at the rear end of the cylinder, said handle being formed with two passages which are adapted to be used either as supply or exhaust passages, the outer ends of said passages being threaded to receive the supply-hose nipple; substantially as described.

22. The combination with a cylinder and its piston, of a handle at the rear end of the cylinder, said handle being formed with two passages which are adapted to be used either as supply or exhaust passages, a valve for controlling one of said passages, and means on the handle for the attachment of the supply-hose nipple to either of said passages; substantially as described.

23. The combination with a cylinder and its piston, of a handle at the rear end of the cylinder, said handle being formed with a passage through its grasping portion, and a passage through its base, and means for attaching the supply-hose nipple to either of said passages; substantially as described.

24. The combination with a cylinder and its piston, of a handle at the rear end of the cylinder, said handle being formed with two passages 20 and 21, which are adapted to be used either as supply or exhaust passages, said handle being capable of rotation relative to the cylinder, and a valve for controlling one of said passages, which controlled passage when used as a supply-inlet, and throttled, will cause the piston to run slow and deliver light blows, the piston having a free exhaust, and which controlled passage when used as an exhaust-port, and the exhaust choked, will cause the piston to deliver blows of full strength at intervals, the length of said intervals being regulated by controlling the exhaust; substantially as described.

25. In an engine, the combination with the cylinder and its piston, of a piston-controlling valve, and means for controlling the exhaust or the admission of the motive fluid to and from the piston independently of the exhaust of the piston-controlling valve; substantially as described.

26. The combination with a piston which has a constant pressure on one side, and an intermittent pressure on its other side, a valve for controlling said intermittent pressure and piston, and cylinder-ports which coöperate with each other to throw the valve; substantially as described.

27. The combination with a cylinder having two diameters in its bore, of a piston having a head and body portion operating in said bore of two diameters, said piston having a constant pressure in front of its head, and an intermittent pressure controlled by a suitable valve behind the piston, and cylinder-ports 25 and 26 leading to the end of the valve, with which ports coöperate piston-ports 24 and 27; substantially as described.

28. The combination with the piston having a port 24 constantly open to pressure, of cylinder-ports 25 and 26 with which the port 24 registers at each extreme of the piston-stroke to admit pressure to the ends of the piston-controlling valve, and a port 27 in the piston for coöperating with the cylinder-port 26 to exhaust one end of the valve, the other end of the valve being exhausted by the front end of the piston-uncovering port 25; substantially as described.

29. The combination with the cylinder, of a valve-block formed with ports 21^a, 22, and 29, a three-headed valve coöperating with said ports, a port 23 which admits the motive fluid in front of the piston-head where it exerts a constant pressure to force the piston to the rear, and means for throwing the piston-controlling valve so as to admit an intermittent pressure behind the piston, said means comprising piston-ports 24 and 27 which coöperate with cylinder-ports 25 and 26; substantially as described.

30. In an engine, the combination with the cylinder bored to two different diameters, of a piston having two diameters operating in said cylinder, a valve for intermittently admitting and exhausing pressure behind the larger head of the piston, said piston controlling the movement of the valve, and two passages which lead to the valve-chamber, one of which passages is controlled, and said passages being adapted to be used either as a supply-inlet or exhaust, said passages being also capable of being changed relative to the cylinder; substantially as described.

31. In an engine, the combination with the cylinder, of a piston having a constant pressure in front thereof, a valve for intermittently admitting pressure at the rear of the

piston, a port in the piston which is constantly open to said pressure in front of the piston, cylinder-ports leading to the ends of the valve-chamber, with which cylinder-ports the piston-port alternately registers to throw the valve, and suitable ports for exhausting the ends of the valve-chamber alternately and at the proper time; substantially as described.

In testimony whereof I hereunto affix my signature, in presence of two witnesses, this 24th day of March, 1896.

FRANK C. RINSCHE.

Witnesses:
F. R. CORNWALL,
HUGH K. WAGNER.