A. PALMROS.

PRESSURE DRIVEN RECIPROCATING TOOL.

APPLICATION FILED APR. 4, 1908.

937,009.

Patented Oct. 12, 1909.

2 SHEETS—SHEET 1.

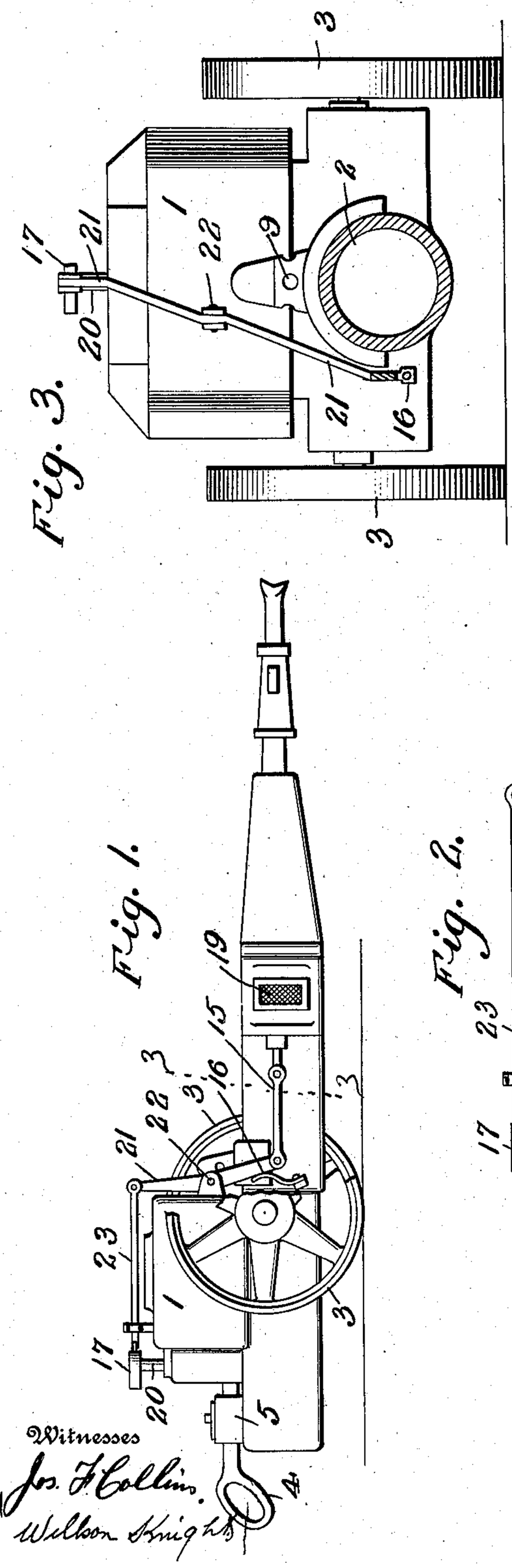

Fig. 3.

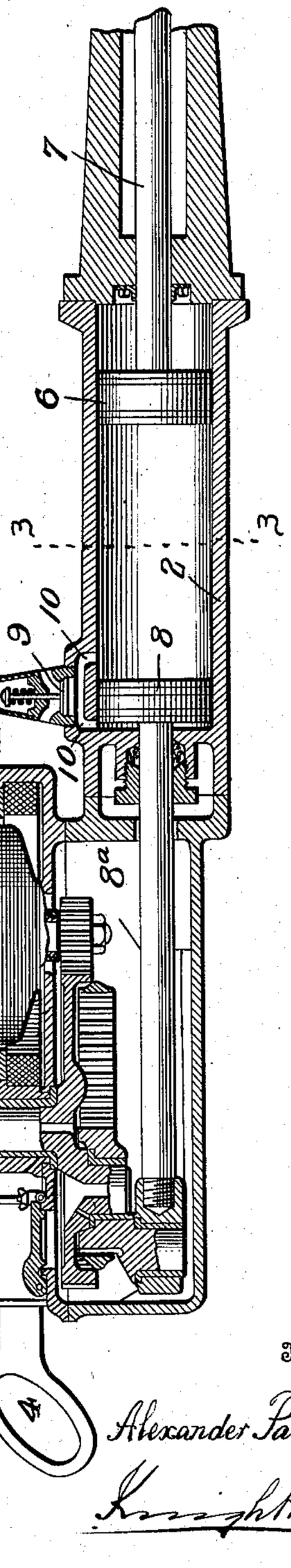

Fig. 2.

Fig. 1.

Witnesses

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2 SHEETS—SHEET 2.

Fig. 4.

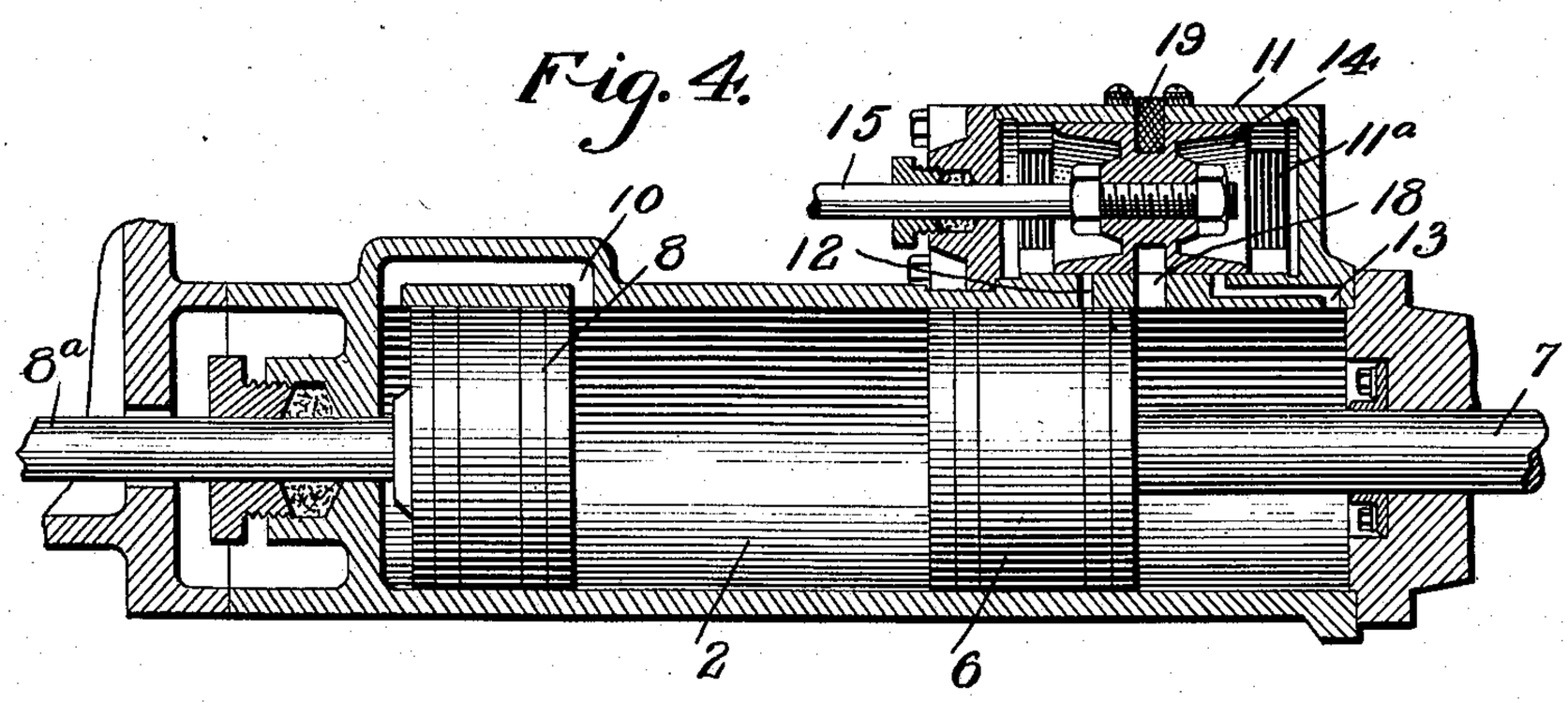


Fig. 5.

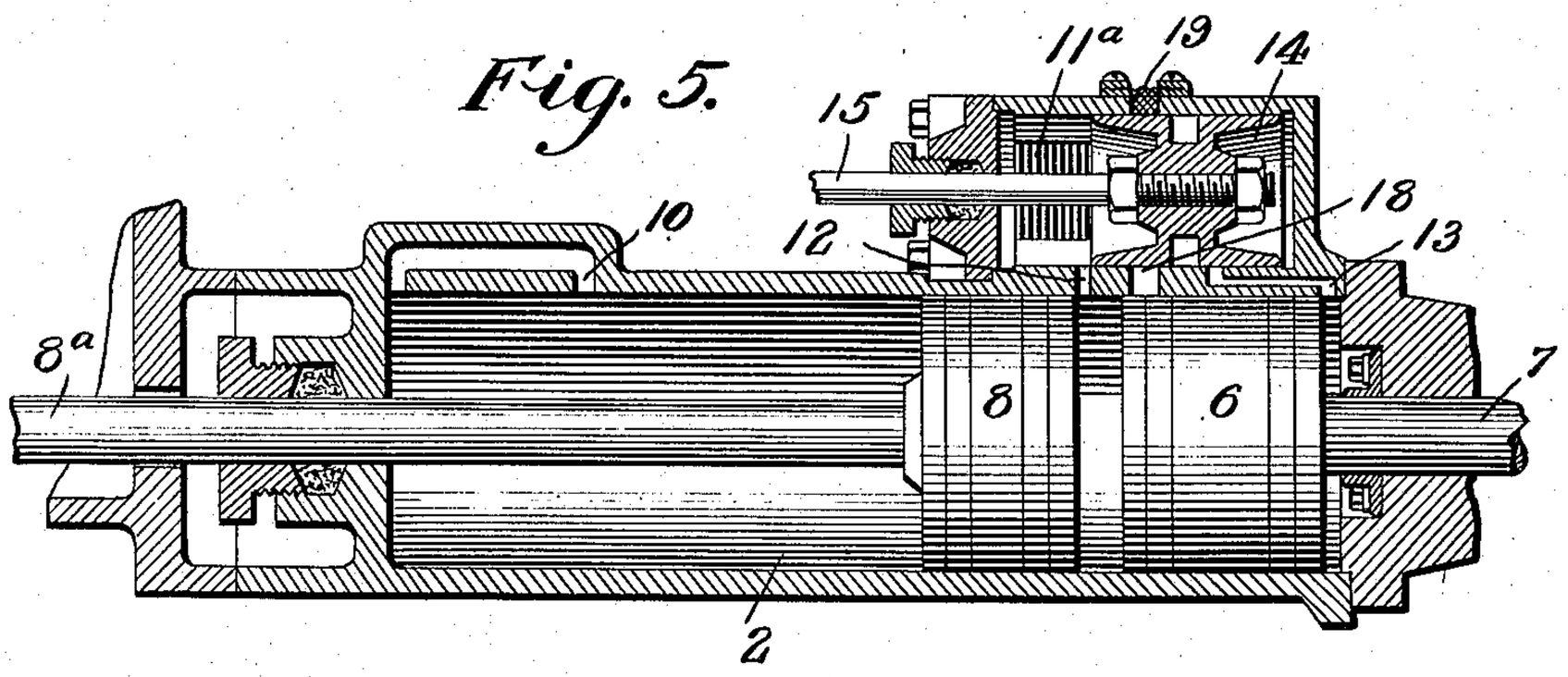


Fig. 6.

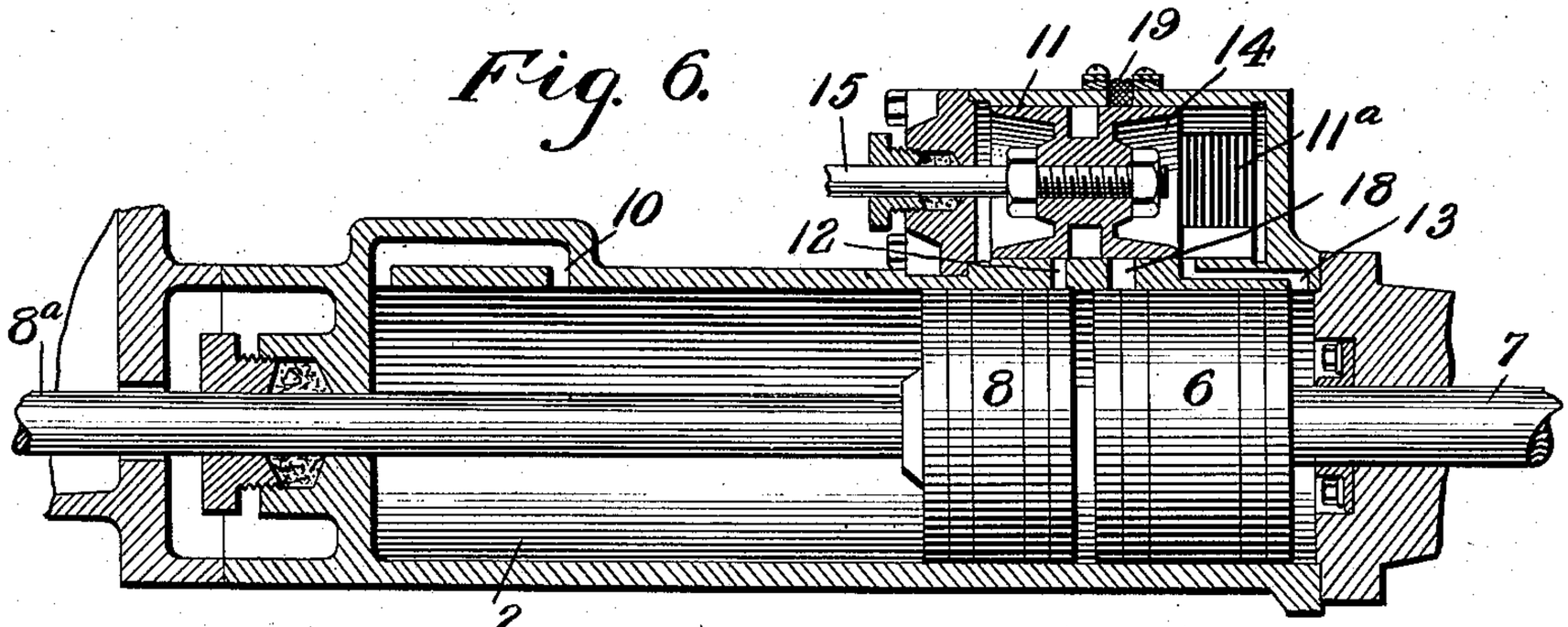
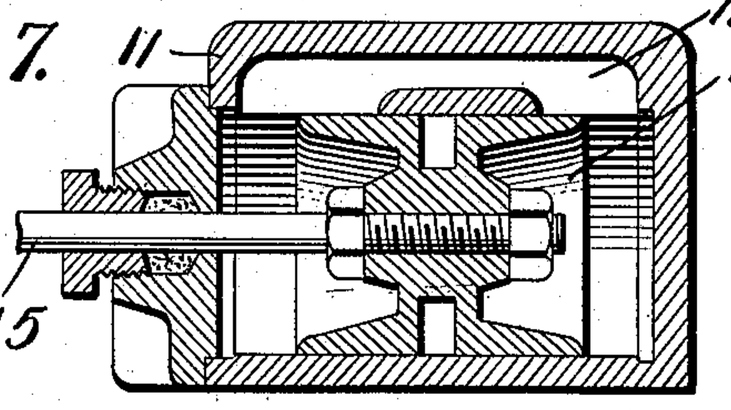


Fig. 7.



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UNITED STATES PATENT OFFICE.

ALEXANDER PALMROS, OF SYRACUSE, NEW YORK, ASSIGNOR TO THE PNEUMELECTRIC MACHINE COMPANY, OF SYRACUSE, NEW YORK, A CORPORATION OF NEW YORK.

PRESSURE-DRIVEN RECIPROCATING TOOL.

937,009. Specification of Letters Patent. Patented Oct. 12, 1909.

Original application filed November 25, 1905, Serial No. 289,127. Divided and this application filed April 4, 1908. Serial No. 425,189.

REISSUED

To all whom it may concern:

Be it known that I, ALEXANDER PALMROS, a citizen of Finland, and resident of Syracuse, in the county of Onondaga, and State of New York, have invented certain new and useful Improvements in Pressure-Driven Reciprocating Tools, of which the following is a specification.

This application is a division of my application filed November 25, 1905, Serial No. 289,127, wherein I have described and claimed a fluid pressure driven percussion tool comprising a pair of suitably housed pistons connected respectively to the tool carrying shaft and the connecting rod of an actuating motor; the pistons being so related that the driving piston has retracting influence over the driven piston during that stroke of the machine in which the tool draws away from the work and at the same time said driving piston compresses a body of air which, at the end of the retracting stroke of the driven piston, is released and permitted to react upon the driven piston to drive it forward and deliver the working stroke. One of the methods disclosed in my said application for establishing retracting influence is by arranging for the expulsion of the body of driving air after completion of the working stroke and as the driving piston follows it forward and to admit air forward of the driven piston so that when the driving piston draws rearward, it will so far reduce the pressure in rear of the driven piston as to permit the pressure medium in front of it to drive the driven piston backward.

The object of my present invention is to develop a more effective force in front of the driven piston for the purpose of driving it rearward, and to these ends my present invention consists in supplying to the space in front of the driven piston, a portion of the fluid pressure that was utilized to drive the driven piston forward so that as soon as a condition is developed in rear of the driven piston which will make the retracting pressure effective, said driven piston will be retracted positively and promptly and be in a position to receive the next forward driving stroke to the best advantage.

According to another aspect, my present invention consists in trapping or confining a portion of the actuating pressure medium in a pressure driven tool, while said medium is still at an effective density, and thereafter releasing said pressure medium against the forward face of the piston, after suitable reduction of the pressure on its driving face.

My present invention further consists in certain features of construction whereby the several objects of my invention are attained.

In the accompanying drawings, Figure 1 is a side elevation of an electropneumatic coal mining machine in which my present invention is embodied by way of illustration; Fig. 2 is a vertical longitudinal section of the machine shown in Fig. 1, in the plane of the axis of the cylinder; Fig. 3 is a transverse section on the line 3—3, Figs. 1 and 2; Figs. 4, 5 and 6 are longitudinal sections of the working cylinder and storing chamber in the plane of their axes, showing the pistons and the valve in different relative positions; Fig. 7 is an axial section of the storage chamber and its valve taken in a plane at right angles to the plane of the sections shown in Figs. 4, 5 and 6.

1 represents the motor housing and 2 the piston housing or cylinder of an electropneumatic coal mining machine of the type selected for illustration of my present invention, which machine is usually mounted upon wheels 3 and is provided with controlling handles 4 and current controlling switch 5. As these parts have no special connection with my present invention, they need not be further described here.

By referring to Fig. 2 it will be seen that the cylinder 2 contains a driven piston 6 whose rod 7 is designed to receive and carry a suitable bit an a manner well known to those skilled in the art. In the type of machine selected for illustration of my invention, the piston 6 is acted upon expansively by a body of air which is compressed by the retracting stroke of a driving piston 8 which is housed in the same cylinder with the piston 6, said cylinder being provided with valved inlet port 9 through which a new body of air is drawn by each forward stroke of the piston 8, and a by-pass 10 through which said body of air can escape to the space between the pistons 8 and 6, after the body of air has been compressed by the rearward movement of the piston 8

to a position between the ends of said by-pass. During the retracting stroke of the piston 8 the piston 6 is also moved rearward by what we may term the suction of the piston 8, that is to say by atmospheric or other pressure acting upon the forward face of piston 6 simultaneously with the rarefaction of air between the pistons due to the rearward movement of piston 8 from the position shown in Fig. 6. For some purposes it will be sufficient, for retracting piston 6, to simply admit atmospheric air in front of said piston as the piston 8 moves rearward. But according to my present invention, I desire to secure a more positive retracting movement of the piston 6 than is attainable by the mere admission of atmospheric air in front of said piston at the time the air is being rarefied behind it; for which purpose, I provide means such as a valve housing 11 the two ends of which act as a single storage space by reason of their communication through by-pass 11ª (see particularly Fig. 7) for receiving a portion of the pressure medium (see Fig. 5) which drove the piston 6 forward (Figs. 2 and 4) on its preceding stroke, and delivering (Fig. 6) it in front of said piston 6 at the time when it is desired to drive said piston rearward. For this purpose, housing 11 communicates through a port 12 with the cylinder 2 at a point that is in rear of piston 6 when the latter reaches its forward limit (Fig. 5), and also through a port 13 at a point forward of the forward limit of said piston 6, so that the driving pressure medium for the piston 6 may pass into the housing 11 after the piston has received the necessary forward impulse and pass from said housing in front of the piston (Fig. 6); in other words, the housing forms a by-pass around the driven piston at the forward end of the cylinder.

To time the delivery of the pressure medium from the housing 11 to the front face of the piston 6, said housing is provided with a valve 14 controlled by a valve stem 15, which is moved in one direction by a spring 16 and in the other direction by a constantly rotating cam 17. While the piston 6 controls the port 12 of housing 11, it is preferable to have the valve 14 so positioned that it will regulate the opening of said port. It is also preferable to have the valve 14 control an exhaust port 18 (Fig. 4), which discharges into atmosphere at 19. The cam 17 may be conveniently mounted upon the shaft 20 of the motor gear so that it rotates constantly. It is so designed that it will move valve 14 to the position shown in Fig. 5 immediately after the piston 6 reaches its forward limit, and hold it there until piston 8 reaches its forward limit, when the housing 11 will have been charged with air under considerable pressure. Then cam 17 moves valve 14 to close the port 12 and the exhaust port 18 and open port 13 (Fig. 6), which occurs at the time piston 8 starts rearward. This releases the pressure medium in the forward end of housing 11 through by-pass 11ª and port 13 to the space in front of the piston 6 and drives the latter reaward, as air is exhausted behind it, with much greater force than if atmosphere alone were depended upon. As soon as the retraction is complete or has developed sufficiently to insure completion by the momentum of the parts, cam 17 moves valve 14 to an intermediate position (Fig. 4), at which it opens the exhaust 18—19, so as to avoid resistance to the forward movement of piston 6.

The rod 15 is not connected directly with the cam, but for convenience is connected to a lever 21, fulcrumed at 22, which is in turn brought under the influence of the cam through the medium of the push rod 23. As these details are not of the essence of my invention, they may obviously be modified at will and according to circumstances.

It is to be understood that the piston 8 is constantly reciprocated through its rod 8ª by power received from any suitable source, as for instance, an electric motor located in the motor housing 1. I do not limit myself, however, to any specific means for imparting reciprocation to the piston 8.

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

1. A percussion implement having a suitable, housed pressure-driven piston receiving a pressure-medium on one face to develop a pulsation therein, and automatically controlled means for conducting a portion of the pressure medium which developed the pulsation, to the opposite face of the piston to cause retraction of the piston.

2. A percussion implement having a suitably housed pressure-driven piston receiving a pressure medium on one face to develop a pulsation therein, and means including a port controlled by the piston, passing a portion of the pressure medium, after partial expenditure of its energy, to the opposite face of the piston, to cause retraction of the piston.

3. A percussion implement having a suitably housed pressure-driven piston receiving a pressure medium on one face to develop a pulsation therein, and means trapping a portion of the driving pressure medium and thereafter releasing it against the forward face of the piston.

4. The combination of suitably housed driving and driven pistons having opposed faces; means whereby the driving piston compresses a fluid on its rear face on one stroke, and the fluid under pressure thus developed is delivered between the opposed faces of the pistons to develop a pulsation in

the driven piston, and means delivering a portion of said fluid under pressure to the forward face of the driven piston.

5. In a fluid pressure driven tool the combination of suitably housed driving and driven pistons of which the driving piston exerts retracting influence over the driven piston, in addition to developing the projecting force therefor, and means, independent of the driving piston, delivering a fluid medium under pressure, forward of the driven piston while the driving piston is exerting its retracting influence.

6. In a fluid pressure driven tool the combination of suitably housed driving and driven pistons of which the driving piston exerts retracting influence over the driven piston, in addition to developing the projecting force therefor, and means, trapping a portion of the pressure medium, during the forward stroke and delivering a fluid medium under pressure, forward of the driven piston while the driving piston is exerting its retracting influence.

7. The combination of suitably housed driving and driven pistons of which the driving piston develops pressure in a fluid on its rearward stroke, means delivering said fluid under pressure to the rear face of the driven piston to develop a forward impulse therein, a chamber into which fluid driving medium is forced by the forward stroke of the driving piston, and means delivering the pressure medium from said chamber to the space in front of the driven piston to exert retracting influence on said driven piston.

8. In a fluid pressure driven tool the combination of suitably housed driving and driven pistons of which the driving piston exerts retracting influence over the driven piston, in addition to developing the projecting force therefor, an exhaust port opening communication with the space in front of the driven piston during its forward stroke, and means independent of the driving piston delivering a fluid medium under pressure, forward of the driven piston while the driving piston is exerting its retracting influence.

9. In a fluid pressure driven tool the combination of the driven piston and means receiving a portion of the pressure medium delivered to the rear face of said piston for driving it forward, and communicating the same to the forward face of said piston for driving it rearward.

10. In a fluid pressure driven tool the combination of a piston receiving a fluid under pressure on its rear face to drive it forward, and means receiving a portion of the pressure medium as the piston nears its forward limit, and communicating the same to the forward face of said piston for driving it rearward.

11. The combination of the suitably housed driven piston, the valve chamber communicating with the housing of said piston at a point in rear of the forward limit of the piston and also at a point forward of said limit, whereby said valve chamber receives a portion of the driving pressure medium, and a valve controlling the delivery of said pressure medium to the cylinder forward of said piston.

12. The combination of the suitably housed driven piston, the valve chamber communicating with the housing of said piston at a point in rear of the forward limit of the piston and also at a point forward of said limit, whereby said valve chamber receives a portion of the driving pressure medium, and a valve controlling the delivery of said pressure medium to the cylinder forward of said piston, said valve also controlling said communication in rear of said limit and closing the same till the driven piston has passed.

13. In a fluid pressure driven tool, the combination of the cylinder, the driven piston therein, the valve chamber having communication with the cylinder at a point in rear of the forward limit of the piston and also at a point forward of the said limit, and having an exhaust port; and a valve controlling said communications and exhaust port; said valve opening the cylinder to exhaust during the forward stroke of the piston, admitting driving pressure fluid to the chamber from the cylinder in rear of the driven piston, and then delivering said pressure fluid to the cylinder forward of said piston.

14. In a fluid pressure driven tool the combination of suitably housed compressing and driven pistons, at one stroke of which the compressing piston exhausts the air behind the driven piston and compresses a fluid medium, while at the other stroke, the driven piston receives the medium thus compressed and is driven forward by the same, and a chamber communicating with the housing both forward and rearward of the forward limit of the driven piston, receiving a portion of the pressure medium used to drive the driven piston forward, and delivering said pressure medium forward of the driven piston to drive the latter rearward, as the air is exhausted from the rear of the same by the retracting stroke of the compressing piston.

15. In a fluid pressure driven tool, the combination of suitably housed driving and driven pistons, the motor actuating the driving piston, the chamber receiving driving pressure medium from the rear of driven piston and supplying it to the front thereof, to drive it rearward, a valve in said chamber for opening and closing the communications between the piston housing and the chamber,

and driving connection between said valve and a shaft of the motor.

16. In a fluid-pressure driven tool, a working piston, a cylinder in which said piston works and in which it is subjected to fluid pressure on its rear face to develop its working stroke, and a chamber having a port through which it communicates with the cylinder and receives fluid under pressure therefrom, and having a port communicating with, and returning said fluid under pressure to the forward face of said piston, to drive it rearward.

17. In a fluid-pressure driven tool, a working piston, a cylinder in which said piston works and in which it is subjected to fluid pressure on its rear face to drive it forward and develop its working stroke, and a chamber having suitably controlled ports through which it communicates with said cylinder, both in rear and forward of the said piston, and through which it receives therefrom, under pressure, a part of the fluid that drives the piston forward and returns said fluid under pressure to the forward face of said piston to drive it rearward.

18. In a fluid-pressure driven tool, a working piston, a cylinder in which said piston works and in which it is subjected to fluid pressure on its rear face to drive it forward and develop its working stroke, and a chamber having suitably controlled ports communicating with said cylinder, both in front and in rear of the forward limit of said piston, and receiving fluid under pressure from said cylinder in rear of said piston, and returning said fluid under pressure to said cylinder, forward of said piston, to drive the piston rearward; means being provided to time the opening of such communications.

19. In a fluid-pressure driven tool, a fluid-pressure driven working piston, a cylinder in which said piston works and in which it is subjected on its rear face to the expansive action of the fluid pressure medium, to drive it forward and develop its working stroke, a chamber for storing the fluid medium under pressure, having suitably controlled ports communicating with said cylinder, through which it receives fluid medium under pressure therefrom, and returns said fluid under pressure to the forward face of said working piston to drive it rearward, and a suitably housed pressure-developing piston, supplying said fluid-medium under pressure.

20. In a fluid-pressure driven tool, a fluid-pressure driven working piston, a cylinder in which said piston works and in which it is subjected on its rear face to the expansive action of the fluid pressure medium, to drive it forward and develop its working stroke, a chamber for storing the fluid medium under pressure, having suitably controlled ports communicating with said cylinder, through which it receives fluid medium under pressure therefrom, and returns said fluid under pressure to the forward end of said working piston to drive it rearward, and a suitably housed pressure-developing piston, supplying said fluid-medium under pressure compressing the pressure medium on one stroke and on the other stroke forcing said medium, under pressure, into the storage chamber.

21. In a fluid-pressure driven tool, a fluid-pressure driven working piston, a cylinder in which said piston works and in which it is subjected on its rear face to the expansive action of the fluid pressure medium, to drive it forward and develop its working stroke, a chamber for storing the fluid medium under pressure, having suitably controlled ports communicating with said cylinder, through which it receives fluid medium under pressure from said cylinder, and returns said fluid under pressure to the forward end of said working piston to drive it rearward, and a pressure-developing piston also in said cylinder supplying said fluid-medium under pressure compressing the pressure medium and releasing it into the space between the pistons on one stroke and on the other stroke forcing a portion of said medium, under pressure, into the storage chamber.

22. In a fluid-pressure driven tool, a fluid-pressure driven working piston, a cylinder in which said piston works and in which it is subjected to fluid pressure on its rear face to drive it forward and develop its working stroke, a chamber communicating with said cylinder, receiving fluid under pressure therefrom, and returning said fluid under pressure to the forward face of said piston to drive it rearward, a motor-driven compressing piston also working in said cylinder, compressing a charge of fluid on its rearward stroke, there being means for delivering said charge under pressure thus developed, to the space between the pistons, whereby it drives the pressure-driven piston forward by its expansion, and said compressing piston thereafter following the pressure-driven piston forward, to introduce a new charge in rear of said compressing piston and displace pressure medium from between the pistons into the chamber.

23. In apparatus of the class described, the combination with a reciprocatory gas-driven member, carrying a tool, of a reciprocatory gas compressor associated therewith, and adapted to actuate said tool, and a positively driven associated valve-mechanism, adapted intermittently to open to the atmosphere, the space in advance of the driven member.

24. In apparatus of the class described, the combination with a reciprocatory gas-driven member, carrying a tool, of a reciprocatory gas compressor associated therewith, and adapted to actuate said tool, and a positively driven associated valve-mechanism, adapted

intermittently to open to the atmosphere, the space in advance of the driven member, and close such space during the retracting thereof.

25. A machine of the class described comprising a cylinder, tool-operating and fluid-compressing pistons independently reciprocable in said cylinder, said machine being provided with a by-pass permanently closed to the atmosphere, and said machine also having ports for conducting compressed fluid from one side of one of said pistons to a space between said pistons.

26. A machine of the class described comprising a cylinder and a tool operating fluid pressure driven piston and a fluid compressing piston, independently reciprocable in said cylinder; said machine being provided with a by-pass permanently closed to the atmosphere for conducting fluid from the space between the pistons to the space forward of the fluid pressure-driven piston, said machine also having ports for conducting compressed fluid from the compressing side of the compressing piston to a space between said pistons.

27. A machine of the class described comprising a cylinder, tool-operating and fluid-compressing pistons independently reciprocable in said cylinder, said machine being provided with a by-pass permanently closed to the atmosphere, said machine also having ports for conducting compressed fluid from one side of the fluid compressing piston to a space between said pistons, and means for conducting fluid to the tool operating piston for retracting the latter.

28. A machine of the class described comprising a casing provided with a cylinder, tool operating and fluid compressing pistons independently reciprocable therein, the casing being provided with a by pass permanently closed to the atmosphere, said machine also having ports for conducting compressed fluid from one side of the compressing piston to a space between the latter piston and the tool operating piston, and means for conducting fluid to the tool-operating piston for retracting the latter.

29. A machine of the class described comprising a cylinder, air compressing and tool-operating pistons, independently reciprocable in said cylinder, and by-passes at the respective ends of said cylinder, having ports by which they respectively communicate between the interpiston space and the outer faces of the two pistons.

30. A machine of the class described comprising a cylinder, air compressing and tool-operating pistons, independently reciprocable in said cylinder, and by-passes at the respective ends of said cylinder, having ports by which they respectively communicate between the interpiston space and the outer faces of the two pistons, said cylinder also having at its respective ends, controlled ports communicating with atmosphere.

31. A machine of the class described comprising a cylinder, air compressing and tool-operating pistons, independently reciprocable in said cylinder, and by-passes at the respective ends of said cylinder, having ports by which they respectively communicate between the interpiston space and the outer faces of the two pistons, said cylinder having air inlet and exhaust ports at its respective ends.

32. A machine of the class described comprising a cylinder, a tool operating fluid pressure driven piston and a fluid compressing piston independently reciprocable in said cylinder, a valve housing secured to the cylinder, and provided with a by-pass and exhaust port, means located within the housing and adapted to prevent communication between the by-pass and exhaust port, the said by-pass being adapted to conduct fluid from the space between the pistons to the space forward of the fluid pressure-driven piston, and means being provided for conducting compressed fluid from the compressing side of the compressing piston to a space between said pistons.

33. In a device of the character described, the combination of a percussion cylinder and piston, means for supplying air to the tool end of the percussion cylinder, means for trapping the air at the tool end of the percussion cylinder during the major portion of the return stroke of the tool, means for supplying air to the opposite end of the tool cylinder and effecting the working stroke of the piston, and means for varying the effective pressure of said latter air to limits above and below the normal pressure of the trapped air.

The foregoing specification signed at Syracuse, N. Y., U. S. A., this twenty-first day of December, 1907.

ALEXANDER PALMROS.

In presence of two witnesses:
JOHN E. WOODRUFF,
ELMER C. WARD.