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POWER HAMMER.

APPLICATION FILED FEB. 1, 1907.

936,316.

Patented Oct. 12, 1909.

4 SHEETS—SHEET 1.

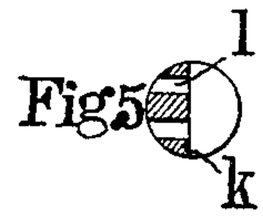

Fig.5

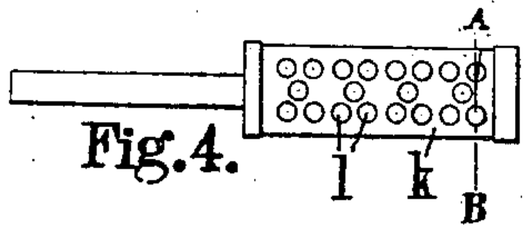

Fig.4.

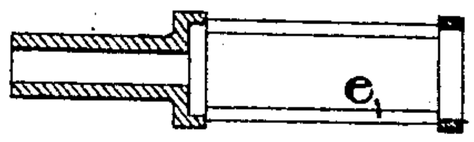

Fig.3.

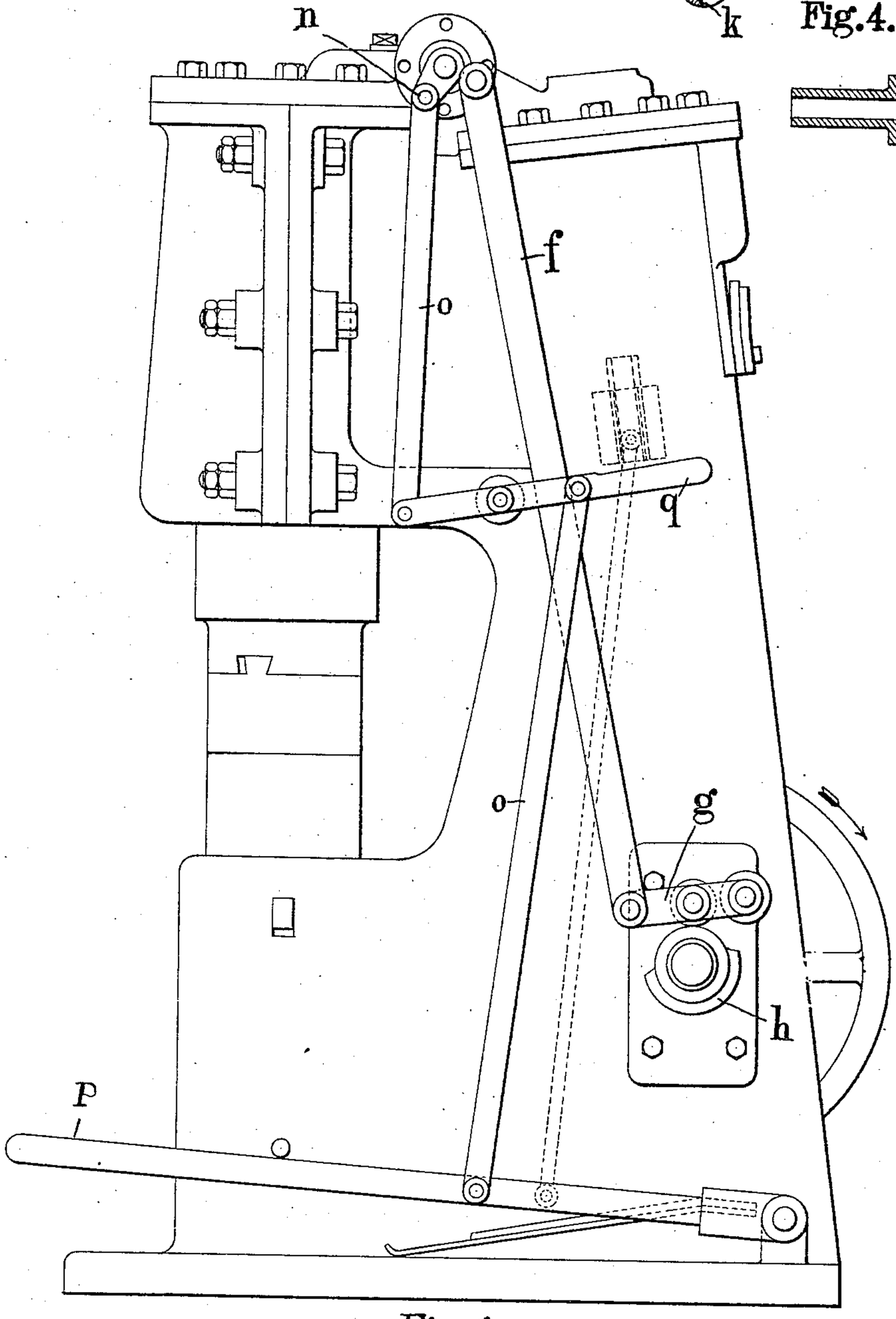

Fig.1.

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4 SHEETS—SHEET 2.

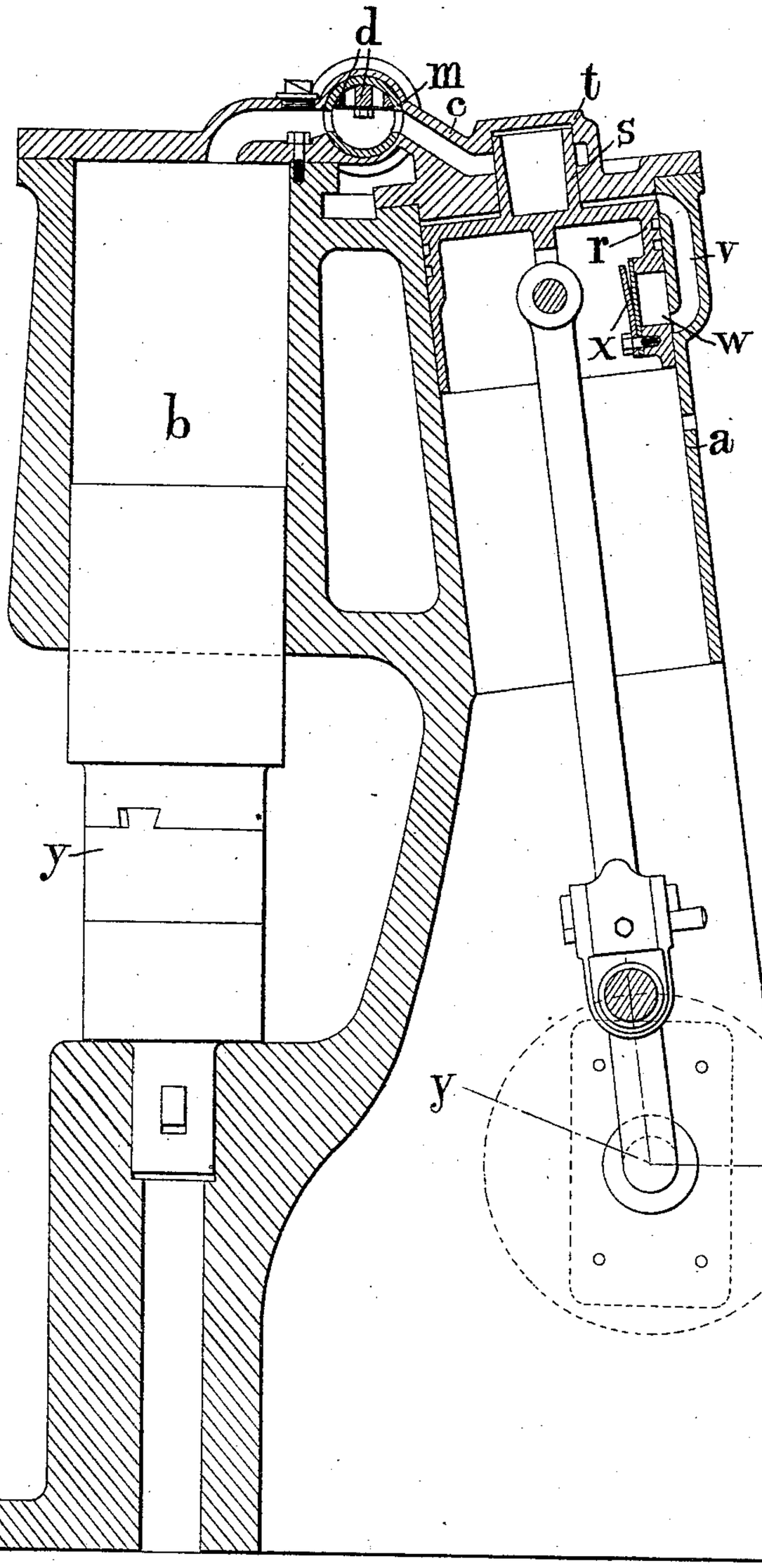

Fig. 2.

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4 SHEETS—SHEET 3.

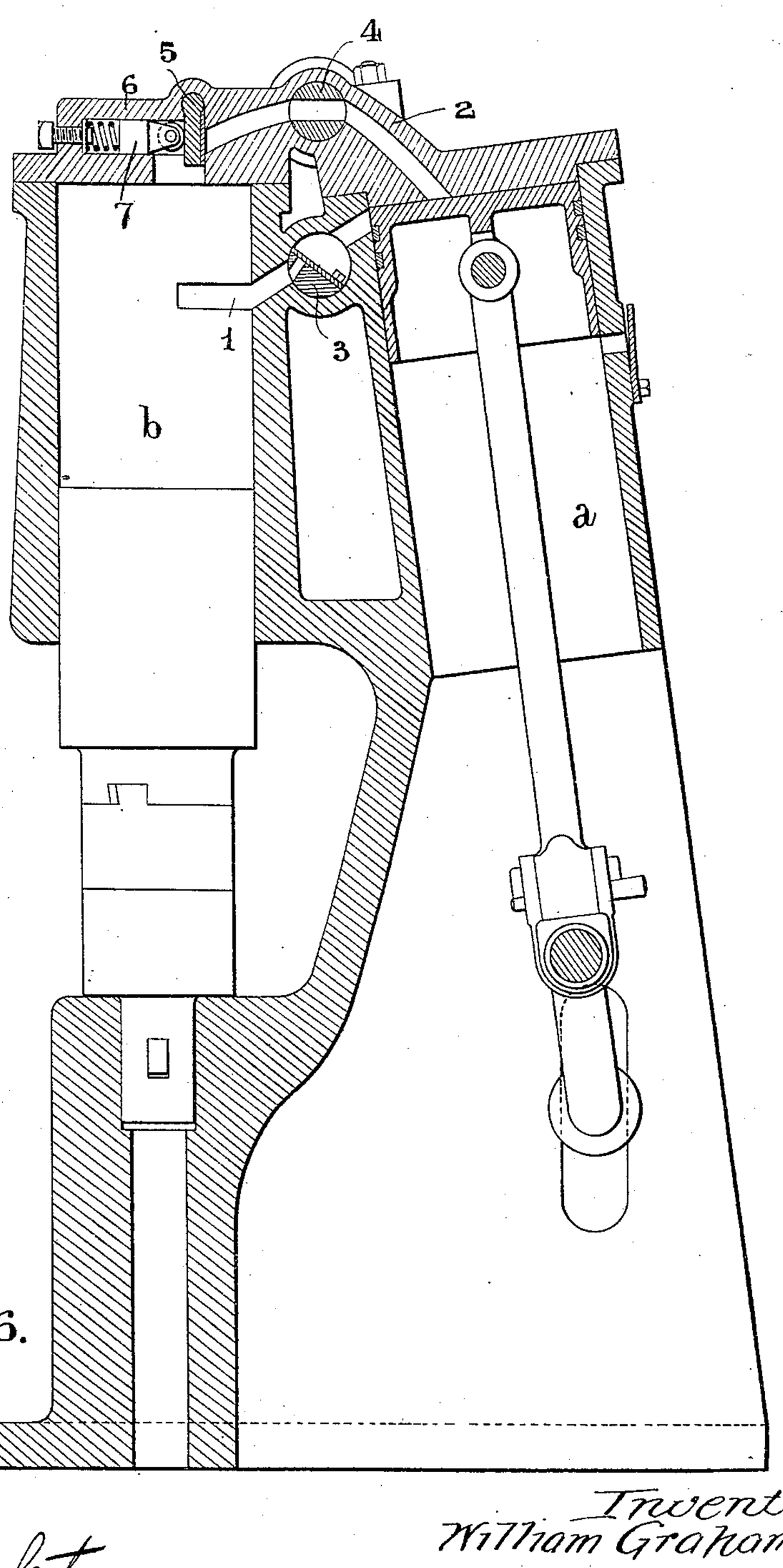

Fig. 6.

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4 SHEETS—SHEET 4.

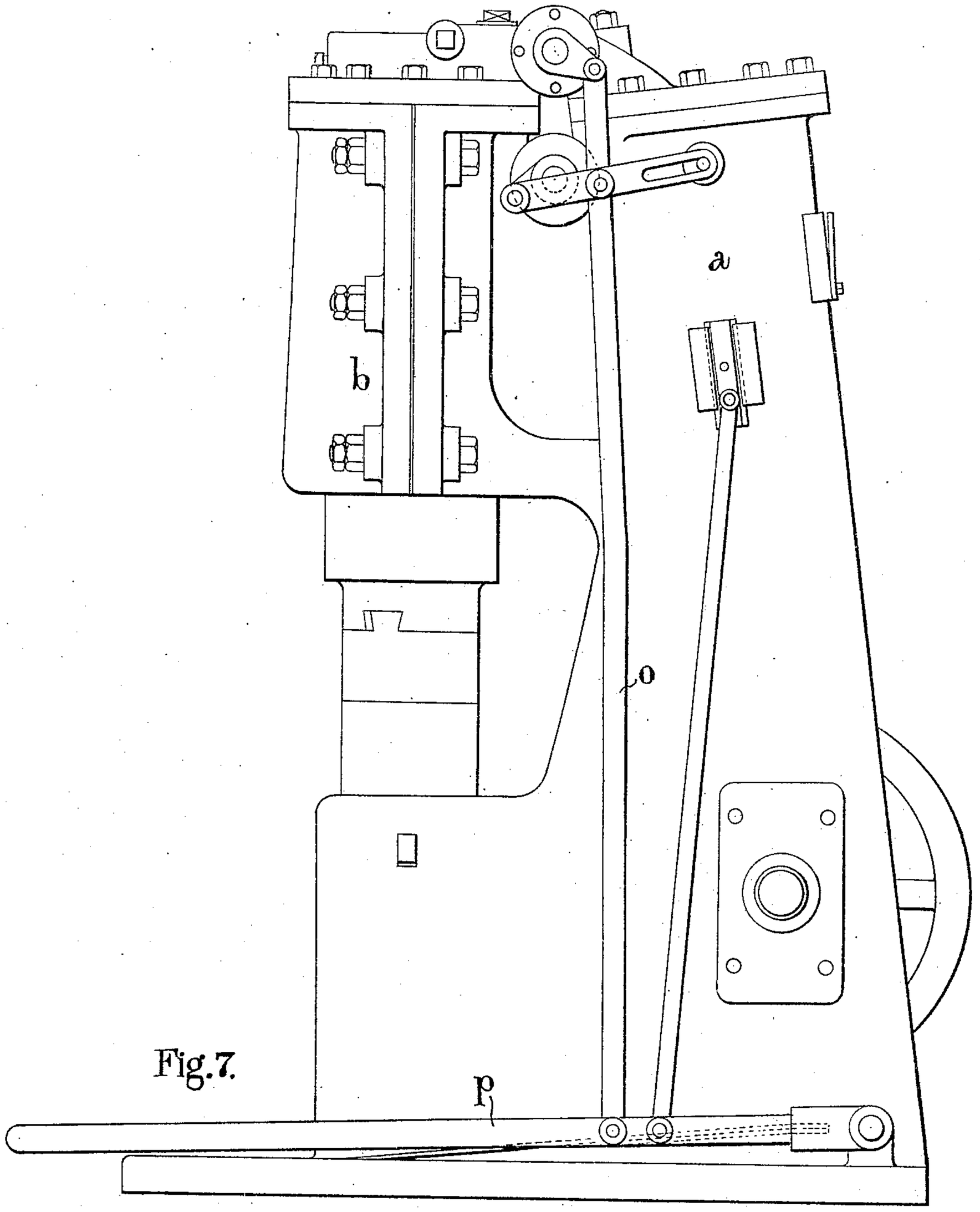

Fig. 7.

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UNITED STATES PATENT OFFICE.

WILLIAM GRAHAM, OF WESTMINSTER, LONDON, ENGLAND.

POWER-HAMMER.

936,316. Specification of Letters Patent. Patented Oct. 12, 1909.

Application filed February 1, 1907. Serial No. 355,278.

To all whom it may concern:

Be it known that I, WILLIAM GRAHAM, a subject of the King of Great Britain and Ireland, and residing at 3 Rochester row, Westminister, London, in the county of Middlesex, England, have invented certain new and useful Improvements in and Relating to Power-Hammers, of which the following is a specification.

This invention relates to improvements in those pneumatic power hammers in which the tup is raised wholly or partly by vacuum and forced downward by pressure of air, the vacuum and air pressure being created by means of a pump arranged in proximity to the tup chamber of the hammer.

The object of the present invention is to improve the action of these hammers by causing the hammer to give a strong blow with a slight pause on the work after the blow has been delivered. With a continuously running pump this has hitherto been impracticable.

The present invention consists in a pneumatic power hammer driven by a continuously running pump, and arranged to give hard blows on the anvil with a pause at the end of the blow, while at the same time the maximum efficiency is obtained from the compressing device.

The principle utilized in this invention is that when a body of compressed air is admitted to a chamber the pressure exerted by that compressed air is proportional to the size of the chamber and to the amount of compression.

In the construction employed herein the admission of compressed air from the pump to the hammer tup is delayed, so that some considerable pressure is obtained in the pump chamber at the time of admission, this compressed air being admitted to the hammer chamber when the tup is at the top of its stroke, and therefore when the clearance space above the tup is smallest.

The invention also comprises additional means for delaying the lifting of the hammer tup by cutting off the communication between the pump and the tup chamber for a portion of the travel of the pump piston whereby the end of the compression stroke is idle, and the beginning of the vacuum stroke is used for creating some considerable reduction of pressure in the pump chamber before the passage from the pump to the tup chamber is again opened.

It will thus be seen that according to the present invention the admission of compressed air and the vacuum action of the pump may be alike delayed, whereby the result hereinbefore mentioned is obtained in a manner hereinafter set forth.

The invention also comprises a modification in which two passages are provided between the pump and the hammer chamber, and both these passages may be controlled both automatically and by hand or foot, one of the passages being arranged for passing the compressed air to the hammer chamber at the beginning of the downward stroke of the hammer, and only after a predetermined pressure has been created in the pump. In this modification the retarding of the admission of compressed air is obtained by means of a spring or the like controlling a non-return valve.

Referring now to the accompanying drawings:—Figure 1 is a side elevation; and Fig. 2 a vertical section of one modification of my invention, in which the result herein aimed at is obtained by means of a mechanically actuated shell valve, with an inner valve. Fig. 3 is a section of the shell valve in the same; while Figs. 4 and 5 are a plan and section respectively of the inner valve. Fig. 6 shows in section a modification in which the result aimed at in the present invention is obtained by means of a spring controlled non-return valve; while Fig. 7 is a side elevation of this modification.

According to the form shown in Figs. 1 to 5, a pump chamber, *a*, and a tup chamber, *b*, are arranged in an inverted position with their extremities in proximity. The upper ends of the two chambers are connected by a passage, *c*, in which there is provided a shell valve, *e*, operated mechanically from the cam, *h*, Fig. 1, through links, *g* and *f*. Within the valve, *e*, there is provided another valve, *d*, operated by hand through the crank and links *o* and *q*, or by foot through the crank, *n*, upper and lower link, *o*, and treadle, *p*. The valve, *d*, is seen in Figs. 4 and 5, Fig. 5 being a section on the line A B of Fig. 4. The segmental part, *k*, extends between two circular end disks, and is provided with perforations, *l*, while an extension is provided on one side for attachment to the crank, *n*.

A trunk end, *s*, on the piston, *r*, is adapted to enter a recess, *t*, provided in the cover for the purpose hereinafter explained, while a

passage, v, in the cylinder, port w, in the piston and non-return valve, x, are provided to permit of the escape of air from the annular space after said trunk has entered the recess, t, in the cylinder.

The operation of this device is as follows:—Assume the tup, y, resting on the anvil as shown. When the pump piston travels downward no substantial vacuum is created in the tup chamber until the trunk, s, passes out from the recess, t. During this time cam, h, operates the links to open the shell valve, e, into the position shown, the raised part of the cam representing the closed position of the valve, while the lower part represents the open position. When the trunk, s, passes from the recess, t, the high vacuum which obtains in the annular space around the trunk is communicated to the tup chamber, b, and the upward stroke of the tup quickly takes place. At or near the end of the suction stroke, when the crank is about the position X, Fig. 2 the lever, g, rises on to the high part of the cam, h, and thereby closes the shell valve, e. As shown in Fig. 1, this high part of the cam extends for a considerable angle, thereby causing a considerable part of the return stroke of the pump to be completed before the valve, e, is again open. There is thus a considerable pressure created in the pump chamber and as the opening of the valve, e, is effected rapidly when the crank reaches the position, Y, this pressure is quickly communicated to the tup chamber. As the tup is at the top of its stroke, the reduction of pressure in the air after the opening of the valve is comparatively small, so that practically the full compression pressure of the pump is transmitted to the tup and utilized for the purpose of adding force to the blow. Shortly after this impact of air has been transmitted to the tup, the trunk, s, enters the recess, t, and the cycle of operations starts once more.

By adjusting the position of the inner valve, d, which is provided with a flexible non-return valve, m, or the like, the action of the hammer may be readily controlled in the manner now well known as applied to pneumatic power hammers, and no further description of this is necessary.

According to the modification of this invention illustrated in Figs. 6 and 7, I dispense with the mechanically actuated valve, and employ therefor a spring controlled non-return valve, 5, which controls the upper passage, 2, leading from the pump, a, to the tup chamber, b. An additional passage, 1, in which is a rotatable non-return valve, 3, is provided in this modification for permitting the return of the air from the tup chamber to the pump.

The operation of this device is very similar to that described, except that in this form no trunk s, nor recess, t, is formed on the end of the pump piston and chamber. The valve, 5, under the action of spring, 6, only opens when the pressure within the pump chamber is considerable. In this form the delay or pause of the tup on the anvil may be lengthened by providing a spring on the valve, 3, so as to cause that valve to open only when a considerable vacuum obtains in the pump. This, however, is not essential. A hand or foot operated valve, 4, is provided in the passage, 2, for effecting control of the hammer, this valve being preferably articulated to the valve, 3. When the valve 5 opens the pressure of air acts upon a piston 7 against a spring 6 and thereby prevents the valve 5 acting as a reducing valve.

It will be seen that in the form described with reference to Figs. 1 to 5, the delay in the admission of the air to the cylinder is effected by a positive motion of the valve while in the second described modification spring control is used for effecting the delay.

The improvements according to the present invention may be readily applied especially in the form shown in Figs. 6 and 7 to those pneumatic hammers which are actuated by means of a double acting pump, and I wish it to be understood that such a form is included within the terms of the claims. In such double acting hammers the down-stroke of the pump is generally the lifting stroke, and therefore corresponds to the down or suction stroke, in the forms of the invention illustrated in the accompanying drawings.

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

1. A pneumatic hammer having in combination a tup and tup chamber, a reciprocating pump working in a separate pump chamber, connecting means between said pump and tup chambers, means for closing said connecting means, and means acting automatically to cause a lag between said pump and tup pistons after a blow has been struck until the pump piston has moved outward a predetermined portion of its stroke.

2. A pneumatic hammer having in combination, a tup and tup chamber, a reciprocating pump in proximity to said tup chamber, a connection between the ends of said pump and tup chamber, a mechanically operated ported shell valve in said connection, a non-return valve working within said shell valve, substantially as and for the purposes hereinbefore described.

3. A pneumatic hammer having in combination a tup and tup chamber, a reciprocating pump in proximity to said chamber, a rotating cranked shaft operating said pump, a cam on said shaft, a connection between the ends of said pump and tup chamber, a ported shell valve operated mechanically from

the said cam, a non-return valve within said shell valve, substantially as described.

4. A pneumatic hammer having in combination a tup and tup chamber, a reciprocating pump in proximity to said tup chamber, a rotating cranked shaft driving said pump, a cam, *h*, on said shaft, a connection between the ends of said pump and tup chamber, a cylindrical ported shell valve in said connection links *g* and *f*, arranged to transmit motion from cam, *h*, to the shell valve, a non-return valve working within said ported shell valve and means for rotating said non-return valve for the purpose of manually controlling the operation of the hammer, substantially as described.

5. In a pneumatic hammer having its tup operated directly by a reciprocating pump and a passage between said pump and tup chamber, automatic means for delaying the lifting of the tup after a blow has been struck, comprising trunk, *s*, on the pump piston, a chamber, *t*, on the pump cover with which said pump is arranged to co-act.

6. A pneumatic hammer having in combination a tup and tup chamber continuously working a reciprocating pump in proximity to said tup chamber and a passage connecting said pump and tup chamber, automatic means for delaying the lifting of the tup after a blow has been struck, comprising a trunk, *s*, on the pump piston, a chamber, *t*, on a pump cover with which said trunk, *s*, engages for the later part of the compression stroke, a relief duct, *v*, arranged to permit the escape of air imprisoned behind the pump piston after the trunk, *s*, has engaged with the recess, *t*.

In testimony whereof, I affix my signature in presence of two witnesses.

WILLIAM GRAHAM.

Witnesses:

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FRANCIS J. BIGNELL.