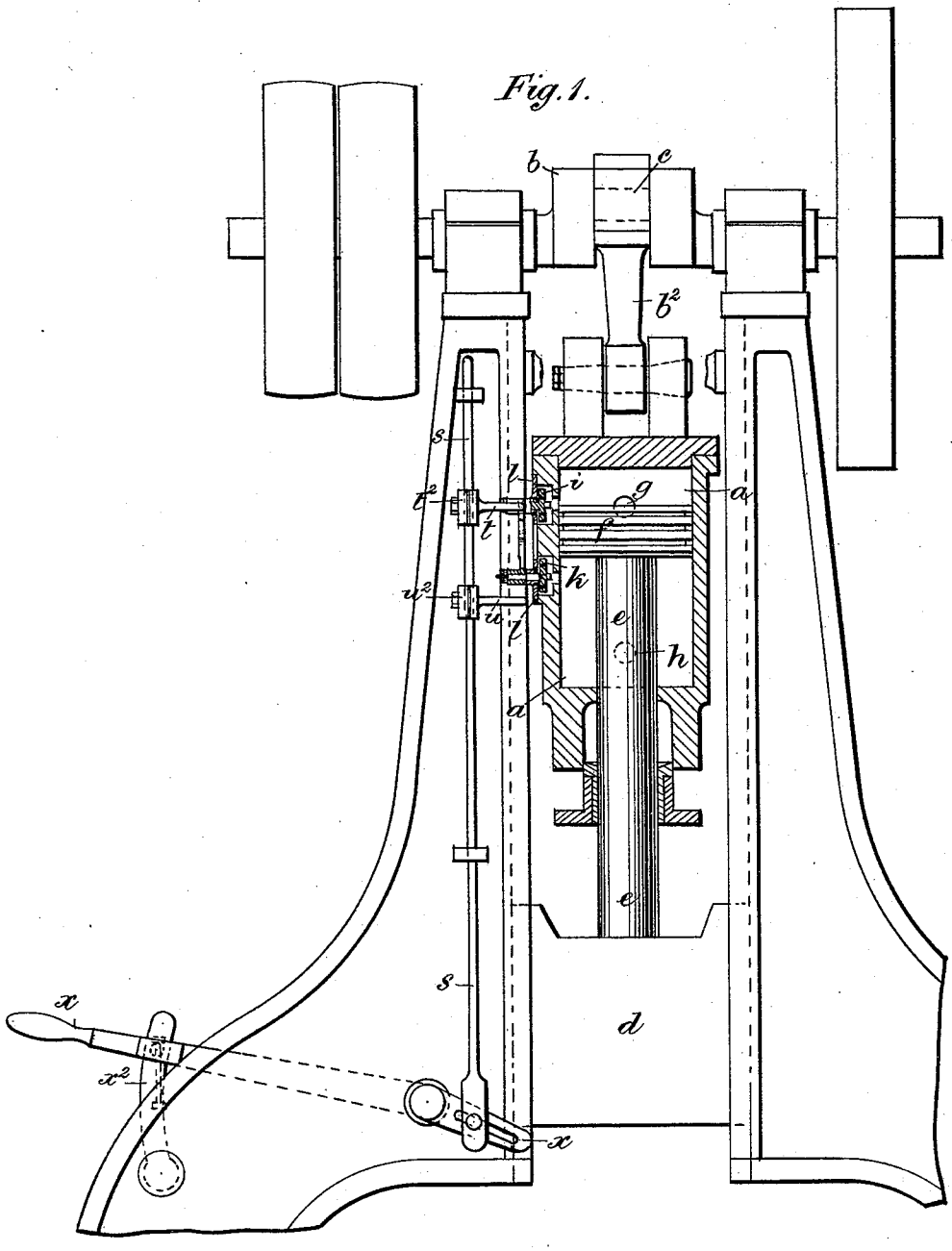
(No Model.) 4 Sheets—Sheet 1.

J. EVANS.

POWER HAMMER.

No. 486,772. Patented Nov. 22, 1892.

Fig. 1.



Witnesses;-

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(No Model.) 4 Sheets—Sheet 2.

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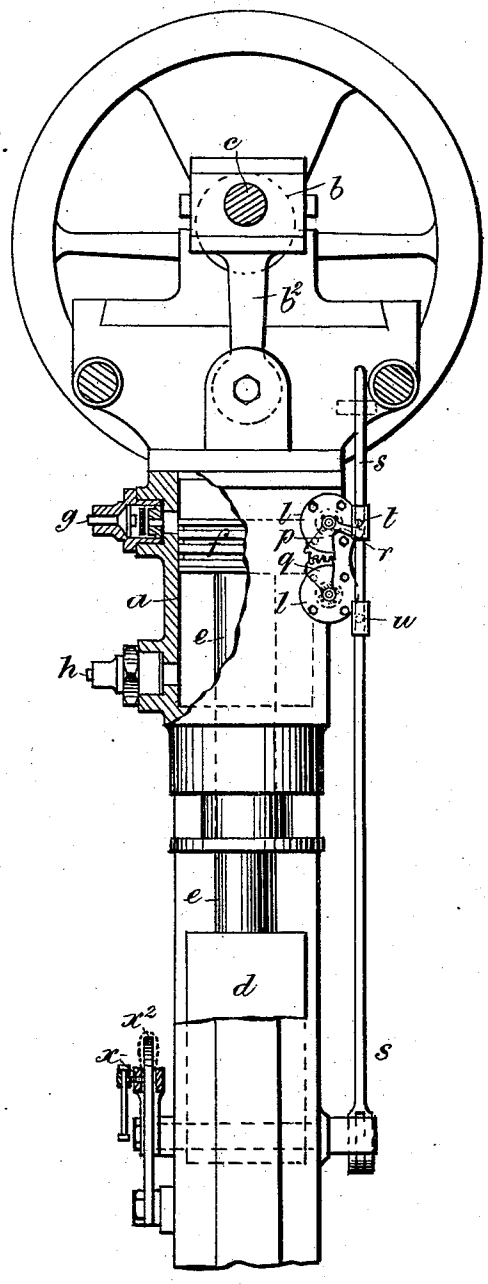
Fig. 2.



Witnesses;—

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(No Model.) 4 Sheets—Sheet 3.

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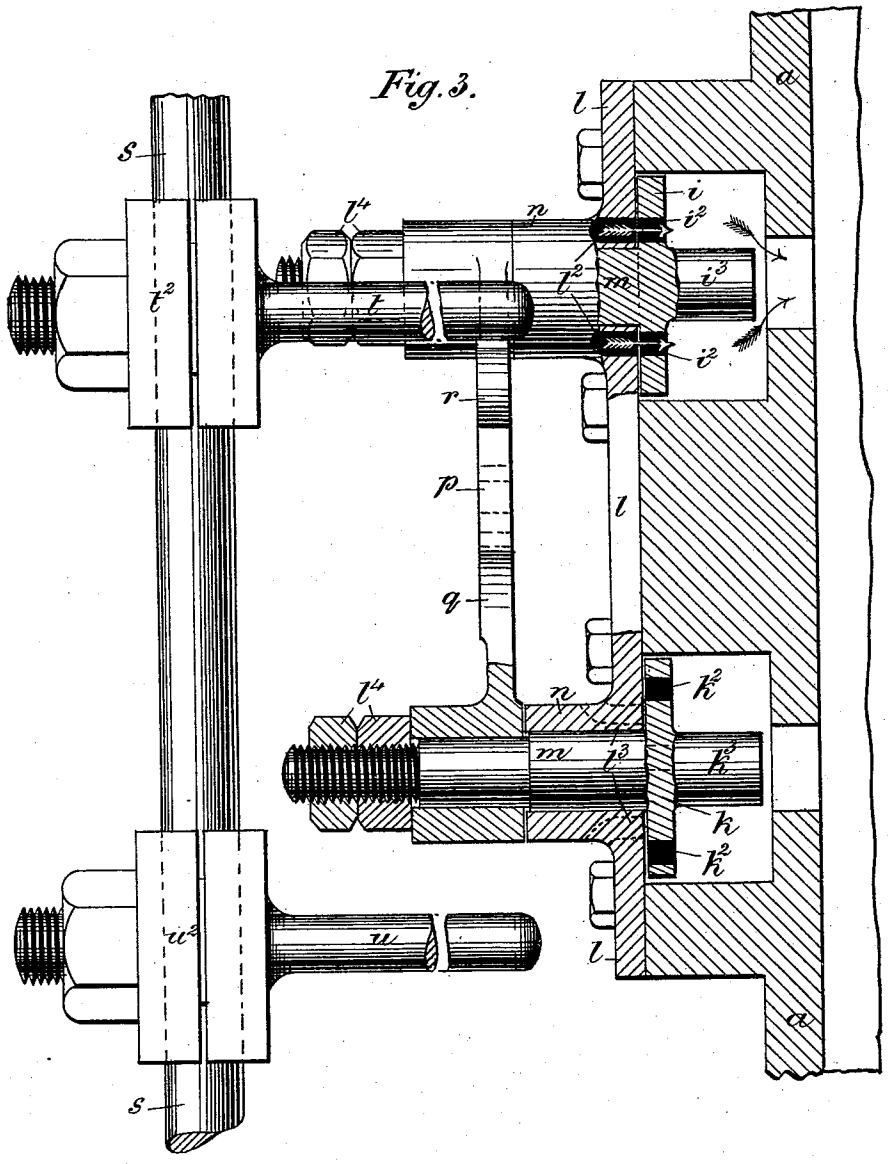
Fig. 3.



Witnesses;-

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(No Model.) 4 Sheets—Sheet 4.

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POWER HAMMER.

No. 486,772. Patented Nov. 22, 1892.

Fig. 4.

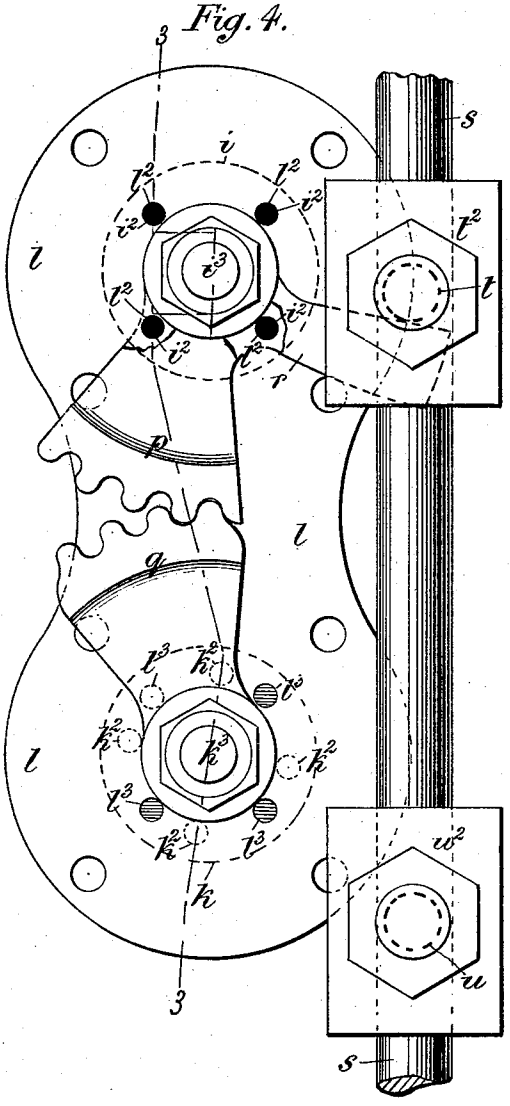


Fig. 5.

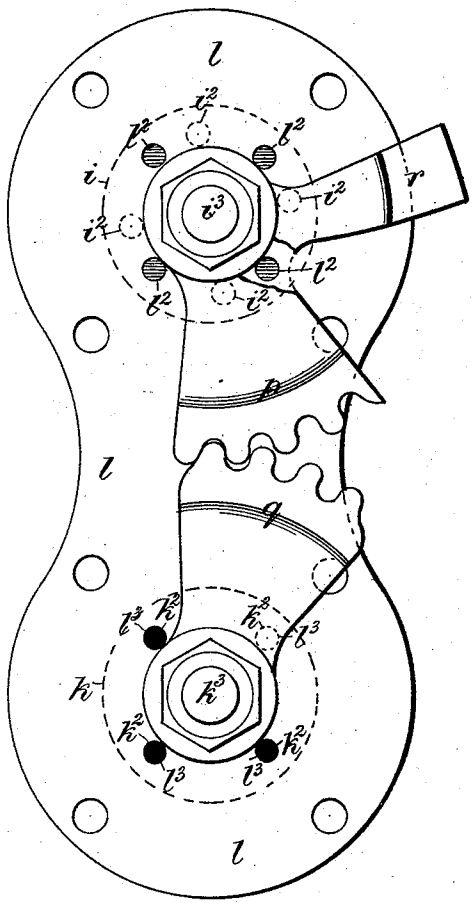
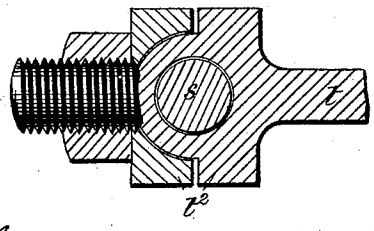


Fig. 6.



Witnesses;-

Richard Skerrett

Arthur John Powell

Inventor;-

Joseph Evans

UNITED STATES PATENT OFFICE.

JOSEPH EVANS, OF BIRMINGHAM, ENGLAND, ASSIGNOR OF ONE-HALF TO ARTHUR WINKLER WILLS, OF SAME PLACE.

POWER-HAMMER.

SPECIFICATION forming part of Letters Patent No. 486,772, dated November 22, 1892.

Application filed March 26, 1892. Serial No. 426,584. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH EVANS, a subject of the Queen of Great Britain, residing at Birmingham, England, have invented certain new and useful Improvements in the Valve Mechanism of Pneumatic Power-Hammers; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention has reference to that class of pneumatic power-hammers in which the piston carrying the trip or hammer-head works in a rising-and-falling air-cylinder, which piston is cushioned at each end of its stroke; and my said invention consists in the adaptation to or combination with the said pneumatic power-hammers of the automatic inlet and escape valves and mechanism connected therewith, hereinafter described, whereby the working parts of the valves are exposed to little friction and wear and the blow of the hammer-head regulated in a simple and efficient manner.

The inlet and escape valves which I use are ported trunnion-valves and are automatically worked. These valves are carried by the air-cylinder and consist of circular disks having ports in them at equidistant points opening into the air-cylinder, which ports by the motion of the valve through a small angle can be made to coincide with or be cut off from similarly-arranged ports in the valve-plate or body secured to the moving air-cylinder, the ports in the said valve plate or body communicating with the external air. These ported circular disks or valves are arranged one near the top of the air-cylinder and the other at a short distance below the middle of the air-cylinder, the said valves being carried by parallel horizontal spindles, the trunnions on which work in bearings in the valve-plate. The bearing-faces of the top and bottom ported valves are pressed to and made to work air-tight against the face of the valve plate or body by means of lock-nuts screwed on the ends of the valve-spindles external to the air-cylinder. The top and bottom valves are geared together by means of toothed sectors on their parallel spindles, the said spindles being so geared together and the valves so arranged upon them that when the top valve is closed the bottom valve is opened, and the reverse. On the upper valve-spindle is a projecting tappet-arm for operating the geared valves. The opening and closing automatically of the two valves is effected as the air-cylinder makes its traveling motion in one or other direction by means of a vertical regulating bar carrying stops or tappets, which are situated in the path of the tappet-arm of the valve mechanism, the said tappet-arm when the air-cylinder nearly reaches the end of its upward stroke striking one of the stops or tappets and when nearly reaching the end of its downstroke striking the other stop or tappet. By the striking of the tappet-arm against one or other of the stops or tappets on the regulating-bar a slight angular motion is given to the tappet-arm and a corresponding angular motion in opposite directions is given to the geared valves, so as simultaneously to open one valve and close the other valve for the cushioning operation within the air-cylinder, as is well understood. The regulating-bar carrying the stops or tappets is connected to a hand or foot lever, and by operating on the said lever the position of the stops or tappets can be adjusted to regulate the blow of the hammer-head.

I will now proceed to describe, with reference to the accompanying drawings, the manner in which my said invention is to be performed.

Figure 1 represents in front elevation, partly in vertical section, and Fig. 2 in side elevation, partly in vertical section, a pneumatic power-hammer to which valve mechanism constructed according to this invention is applied. Fig. 3 represents a vertical sectional view taken on the line 3 3, Fig. 4. Fig. 4 represents a front elevation of the same. Fig. 5 represents the same view of the valves as Fig. 4, excepting that their positions are changed; and Fig. 6 represents a horizontal section of the regulating-bar and a portion of one of the stops or tappets thereon.

In Figs. 1, 2, 3, and 4 the valve mechanism is arranged for the hammer-head to deliver a light blow of the minimum strength, and in Fig. 5 the valve mechanism is arranged for

the hammer-head to deliver a heavy blow of the maximum strength.

The same letters of reference indicate the same parts in the several figures of the drawings.

a is the reciprocating air-cylinder of the pneumatic hammer worked from the crank *b* and connecting-rod b^2 and crank-shaft *c* in the usual way.

d is the trip or hammer-head carried by the piston-rod *e* and the piston *f*, working in the air-cylinder *a*. It will be seen by reference to Fig. 1 that there is no mechanical connection or gearing between the cylinder *a* and piston *f*. The cylinder and piston do not move at the same speed, the cylinder causing the piston to move by producing a compression or expansion of air between either end of it and the piston, as hereinafter described.

g h are atmospheric valves near the top and bottom of the cylinder. These valves constitute no part of this invention and have for their object the admission of air into the cylinder above and below the piston *f* when the air within the said cylinder is of less pressure than that of the external atmosphere, the said valves closing automatically when the pressure of air within the cylinder exceeds that of the external air. As the functions of these valves are well known, I do not consider further explanation necessary.

In order that the action of the valve mechanism constituting this invention may be the better understood, I remark that the strength of the blow to be delivered by the hammer-head *d* is determined by the quantity of air compressed between the bottom of the cylinder and the falling piston and the quantity of air compressed between the top of the piston and cover of the cylinder, so that by opening wholly or partially one of the valves and closing wholly or partially the other valve, the quantity of air to be compressed by the rising and falling piston can be regulated and the strength of the blow changed, as hereinafter particularly described. This is effected by the use of the valve mechanism and appliances constituting this invention, which I will now proceed to describe in detail.

i k are two ported circular valves carried by the air-cylinder for permitting of the entrance of air into and the escape of air from the said cylinder. The ported valve *i* is situated near the top of the air-cylinder *a*, and the other valve *k* near the middle of the air-cylinder, the said valves being supported by the valve-plate *l*, secured to the air-cylinder. The construction and action of the air inlet and escape valves *i k* will be best understood by referring to the enlarged views, Figs. 3, 4, and 5. The ports in the valves *i* and *k* are marked, respectively, i^2 and k^2, and the ports in the valve-plate *l* are marked, respectively, l^2 l^3, the said ports l^2 l^3 opening to the external air. By moving the valves *i k* through a small angle they can be made to open wholly or partially the ports l^2 l^3 and thereby permit air to enter and escape from the cylinder. (See the open top ports and the closed bottom ports in Figs. 3 and 4.) The said valves *i k* are made solid with the parallel horizontal spindles i^3 k^3, and trunnions *m m* on the said spindles work in the hollow bearings *n n* in the valve-plate *l*.

The bearing-faces of the top and bottom valves *i k* are pressed to and made to work air-tight against the face of the valve-plate *l* by the lock-nuts at l^4, screwed on the ends of the valve-spindles, as seen in Fig. 3. The two ported valves *i k* are geared together by means of the toothed sectors *p q* on the parallel spindles i^3 k^3 of the said valves. It will be seen by an examination of the drawings that the two valve-spindles are so geared together and the ported valves so arranged upon them that when the top valve *i* is opened the bottom valve *k* is closed, and the reverse. On the upper valve-spindle i^3 is a projecting tappet-arm *r* for operating the geared valves.

On the side of the hammer-frame is a regulating vertical bar *s*, sliding in guides on the said hammer-frame. This regulating-bar *s* carries two horizontal stops or tappets *t u*, which are situated in the path of the tappet-arm *r* on the top valve of the geared valves. It is by the action of one or other of these stops *t u* on the tappet-arm *r* that the positions of the geared valves can be so changed as to regulate the blow of the hammer-head. The movable stops or tappets *t u* on the sliding regulating-bar *s* are fixed at the required height on it and at the required distance apart by the clamping-plates and nuts at t^2 u^2. (See Fig. 6.) The height of the sliding bar *s*, carrying the stops or tappets *t u*, is adjusted to regulate the blow of the hammer-head by means of the hand-lever *x*, (or other lever,) which is fixed after the bar *s* has been adjusted in the quadrant x^2 by a clamping-screw or otherwise. When the regulating-bar *s* is adjusted in one position, the stop or tappet *t* can be made to operate during the upward motion of the reciprocating cylinder on the geared valves *i k*, through the tappet-arm *r*, and when the regulating-bar *s* is adjusted in another position the other stop or tappet *u* can be made to operate during the downward stroke of the cylinder on the tappet-arm *r* and reverse the positions of the said valves *i k*.

In the hammer represented in Figs. 1 and 2 and in the enlarged views of the valve mechanism represented in Figs. 3 and 4 the regulating-bar *s* has been so adjusted that the tappet-arm *r* of the geared valves has struck the top stop or tappet *t* on the upward motion of the cylinder *a*, thereby fully opening the top valve *i* and fully closing the bottom valve *k*—that is, the turning down of the tappet-arm *r* by striking against the temporarily fixed stop or tappet *t* has moved the ported valve *i* through such an angle as to make its ports coincide with those in the valve-plate *l*. At the same time the other valve *k* has been

moved through the gearing *p q* in an opposite direction, so that its ports do not coincide with those in the valve-plate *l*, as represented. When the valves are so arranged, the minimum quantity of air between the cover of the cylinder and the top of the piston is obtained for cushioning on the ascent of the cylinder and piston and for giving the least initial velocity to the piston on the descent of the cylinder, and the maximum quantity of air in compression is obtained between the bottom of the cylinder and the under side of the piston, by the compression of which maximum quantity of air on the downward motion of the cylinder and piston the said piston is arrested or cushioned and the hammer-head thereby made to give its lightest or minimum blow. On the ascent of the cylinder the piston has the required upward velocity given to it by the expansion of the air between its bottom and the under side of the piston. As the hammer works the reciprocating cylinder *a* carries the tappet-arm *r* between the two stops *t u*, which are temporarily inoperative—that is, as the cylinder *a* rises the tappet-arm *r* just reaches but is not operated by the top stop *t*, and as the cylinder descends the tappet-arm *r* does not reach the bottom stop *u*. The two valves *i k* are thus maintained in the relative positions represented in Figs. 1, 2, 3, and 4 so long as the hammer-head is required to give the blow for which the regulating-bar *s* has been adjusted. When it is desired to change the blow delivered by the hammer-head from a light to a heavy blow, the regulating-bar *s* is raised by the hand-lever *x*, so as to bring into operation the lower stop or tappet *u* and take out of action the upper stop or tappet *t*. When the cylinder *a* now makes its descending stroke, the tappet-arm *r* strikes the now-operating lower stop or tappet *u* and the said tappet-arm *r* is lifted into the position represented in Fig. 5. By this lifting of the tappet-arm *r* the top valve *i* is fully closed and the bottom valve *k* is fully opened, as represented in Fig. 5, the said valves remaining in those positions till the position of the regulating-bar *s* is again changed. By the changed positions of the two valves *i k* last described, and represented in Fig. 5, the maximum quantity of air in compression between the cover of the cylinder and upper side of the piston for cushioning on the ascent of the cylinder and for giving the greatest initial velocity to the piston on the descent of the cylinder is obtained. The quantity of air between the bottom of the cylinder and the under side of the piston is at the same time diminished, so as to offer the least resistance to the downward motion of the piston, and the hammer-head is consequently made to deliver its heaviest or maximum blow. By raising the regulating-bar and its stops to the required position, so as to cause them to act on the tappet-arm *r* and partially open both of the valves *i k*, a blow of the desired intensity may be delivered by the hammer-head. It will thus be understood that during the working of the hammer the ported valves are not operated upon, and are thus relieved from friction or wear, the valves only being moved when it is necessary to reverse or alter their positions for the cushioning operation.

The stops or tappets, instead of being secured to a regulating-bar adjusted by a hand or foot lever, may be secured to a slide or other equivalent arrangement, whereby the positions of the stops or tappets may be adjusted according as a light or heavy blow is required in the hammer.

Having now particularly described and ascertained the nature of the said invention and the manner in which the same is to be performed, I declare that I claim as my invention—

1. The combination, with the reciprocating cylinder of a power-hammer, of the ported valves having parallel spindles supported by parts of the cylinder, and one of which is provided with a tappet-arm, suitable connections between the valve-spindles, and a regulating-bar carrying tappets located in the path of said tappet-arm, so that the striking of the latter against one or the other tappet simultaneously operates the ported valves, substantially as described.

2. The combination, with the reciprocating cylinder of a power-hammer, of the ported valves having parallel spindles supported by parts of the cylinder, and one of which is provided with a tappet-arm, intermeshing gears secured, respectively, to the valve-spindles, and a regulating-bar carrying tappets located in the path of the said tappet-arm, so that the striking of the latter against one or the other tappet simultaneously turns the ported valves, substantially as described.

3. The combination, with the reciprocating cylinder having a valve-plate provided with ports, of the inlet and escape valves, having parallel spindles and provided with ports, gearing between the valve-spindles, and devices for turning one of the valve-spindles and thereby simultaneously turning the valves, substantially as described.

JOSEPH EVANS. [L. S.]

Witnesses:
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ARTHUR JOHN POWELL.