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HAMMERING MACHINERY ACTUATED BY EXPLOSIVE GASEOUS MIXTURES.

No. 384,869. Patented June 19, 1888.

Fig 1.

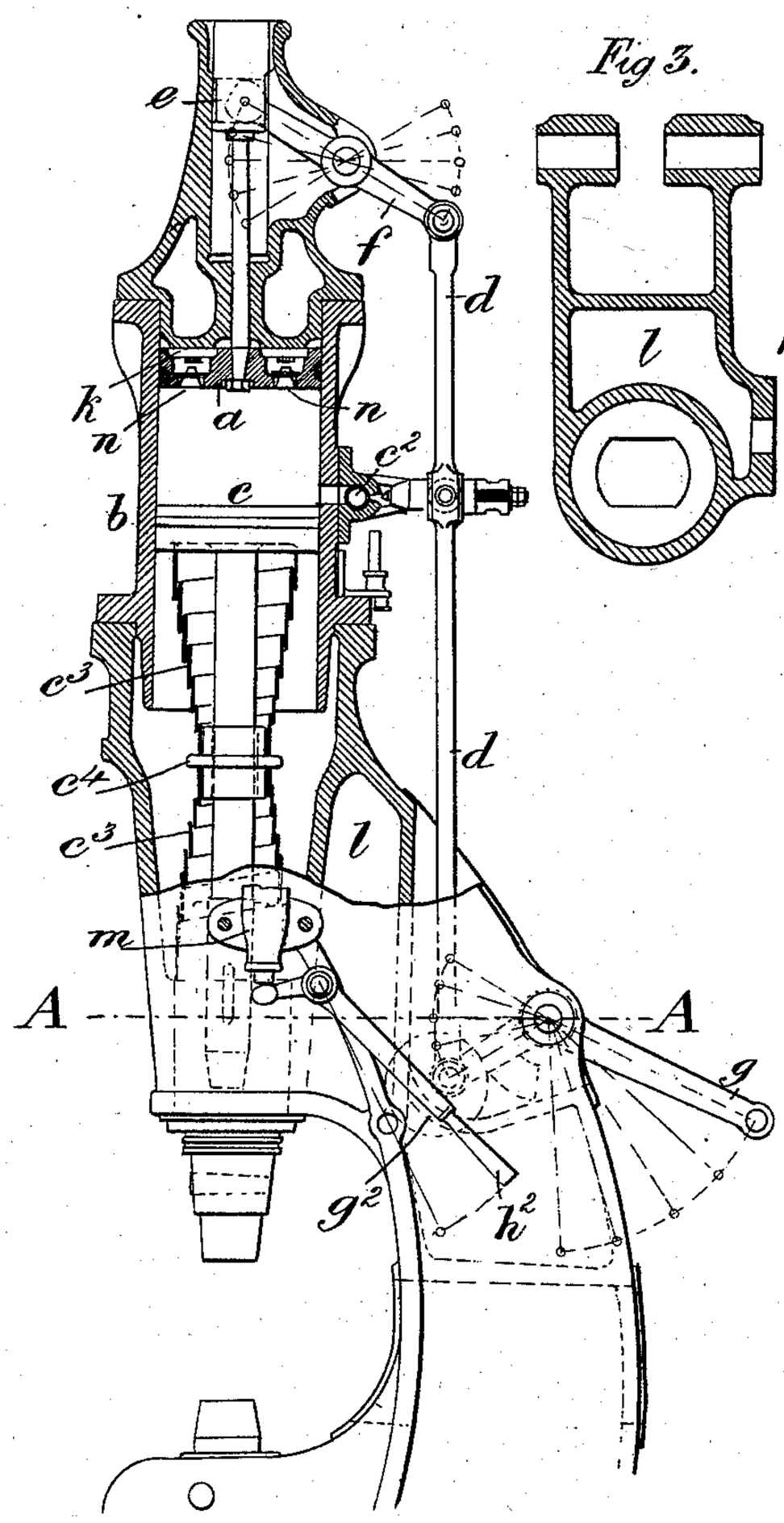

Fig 3.

Fig 2.

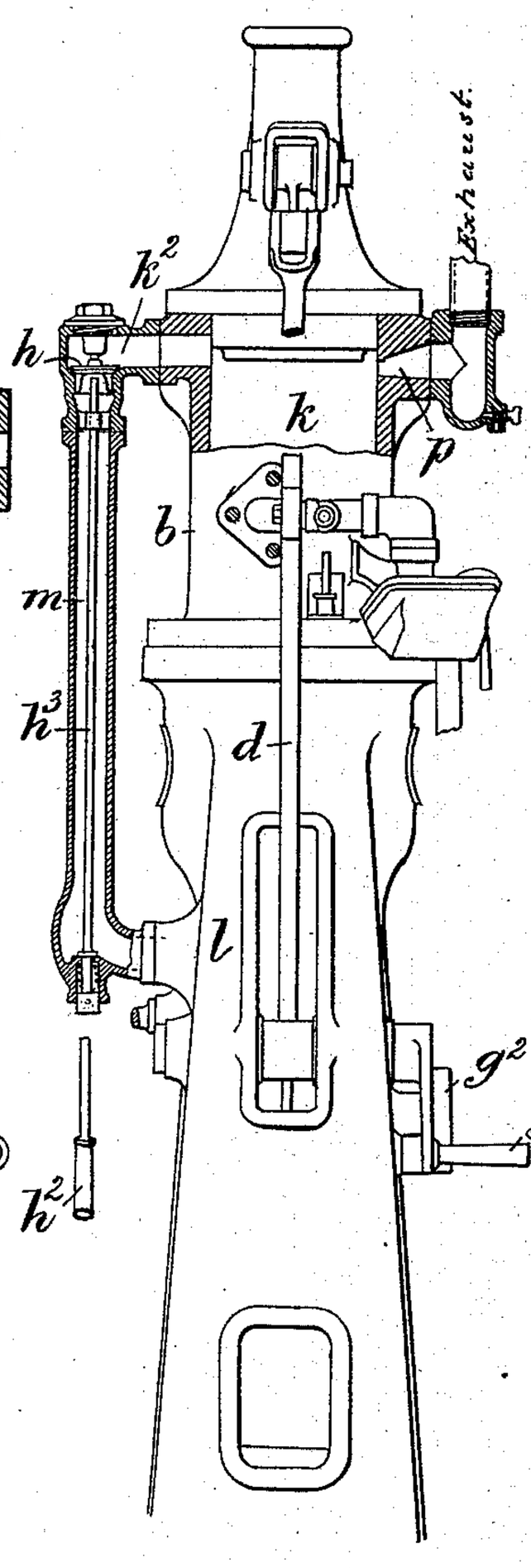

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Fig 4.

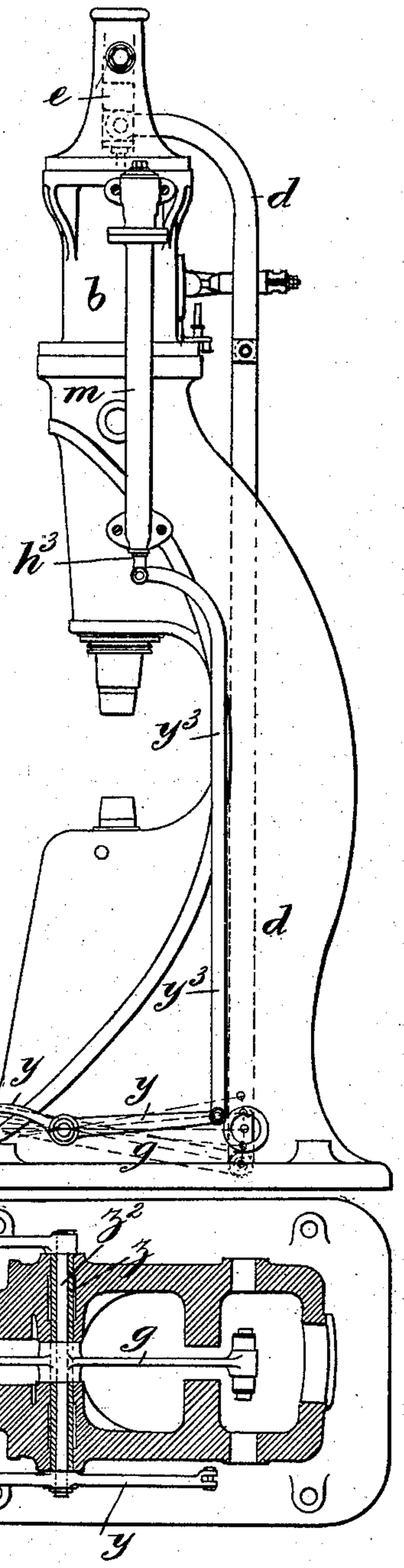

Fig 5.

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Fig 7.

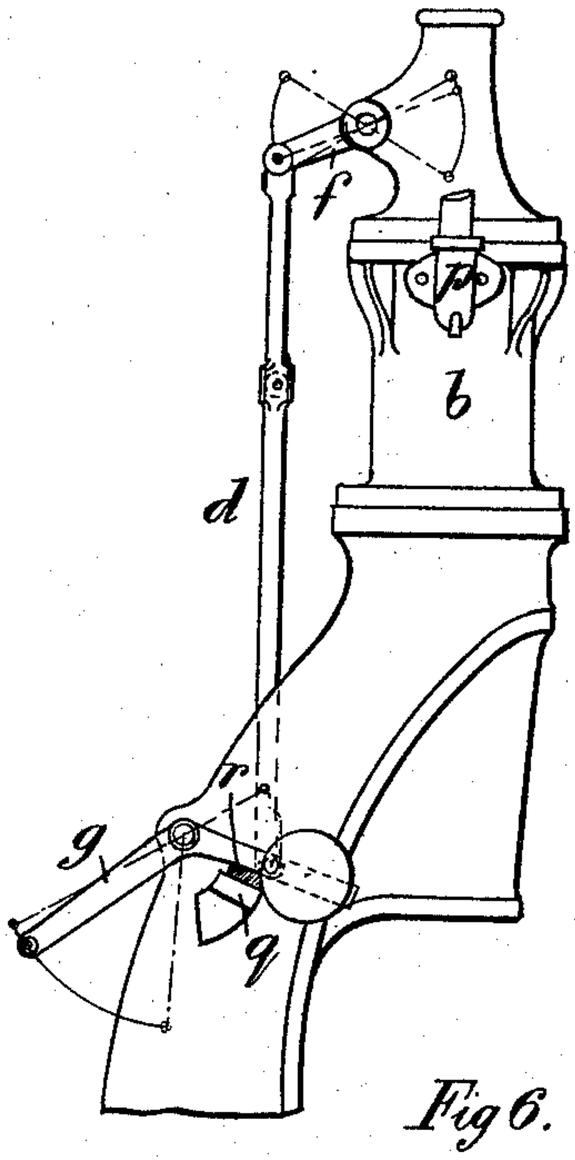


Fig 6.

Fig 8.

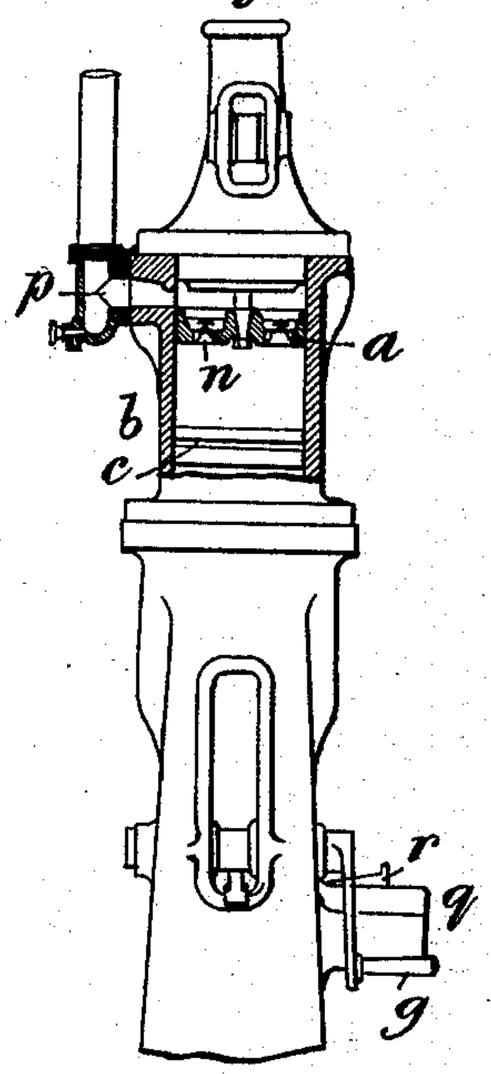
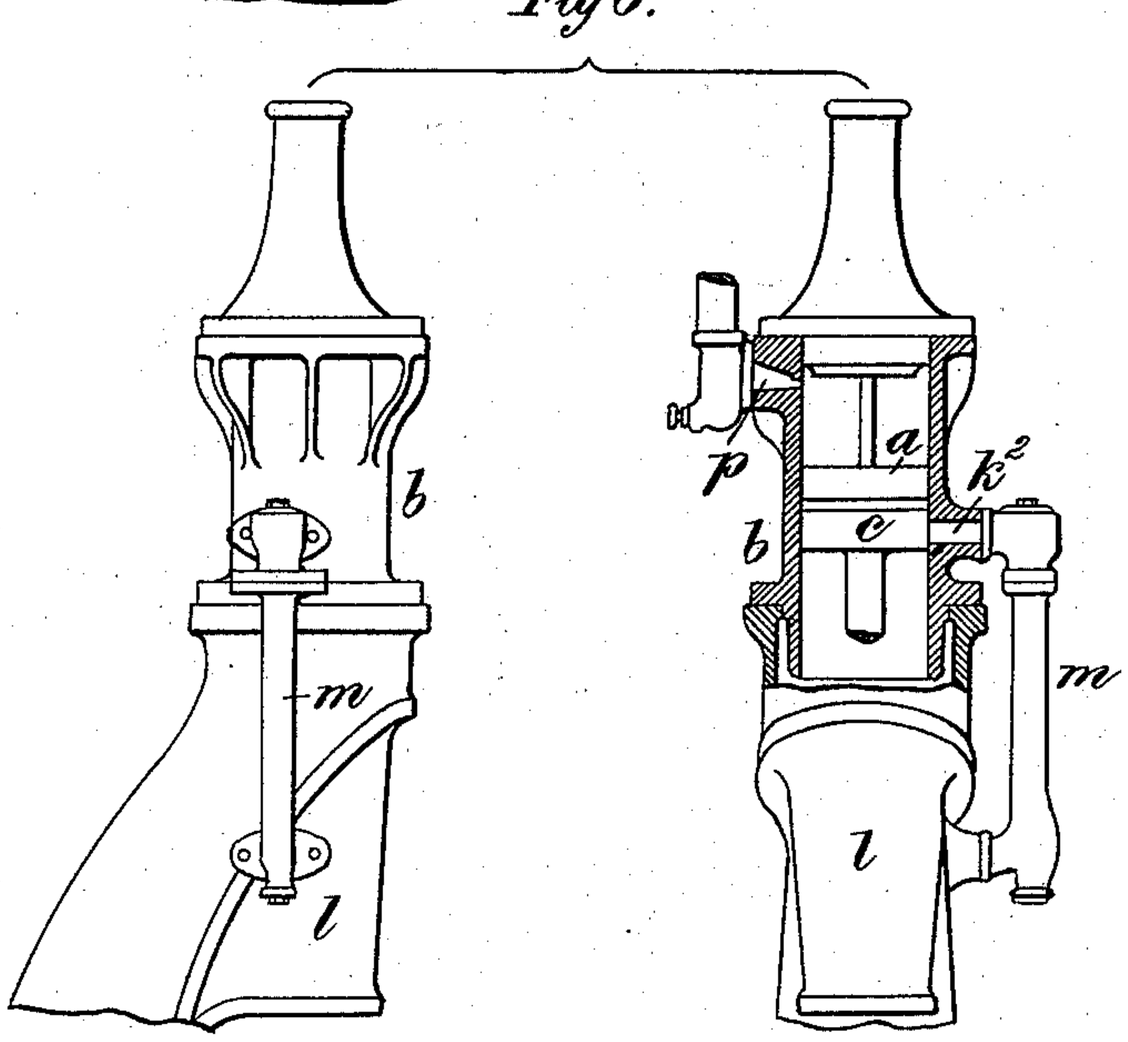


Fig 9.



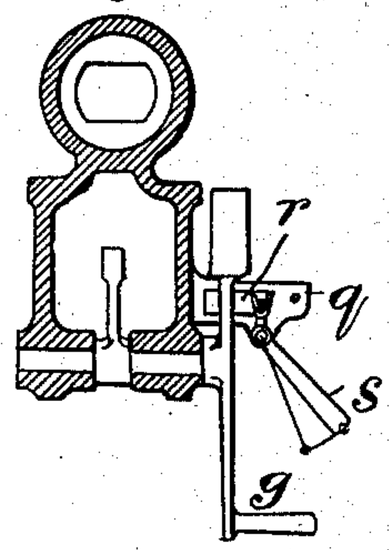


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Fig 10.

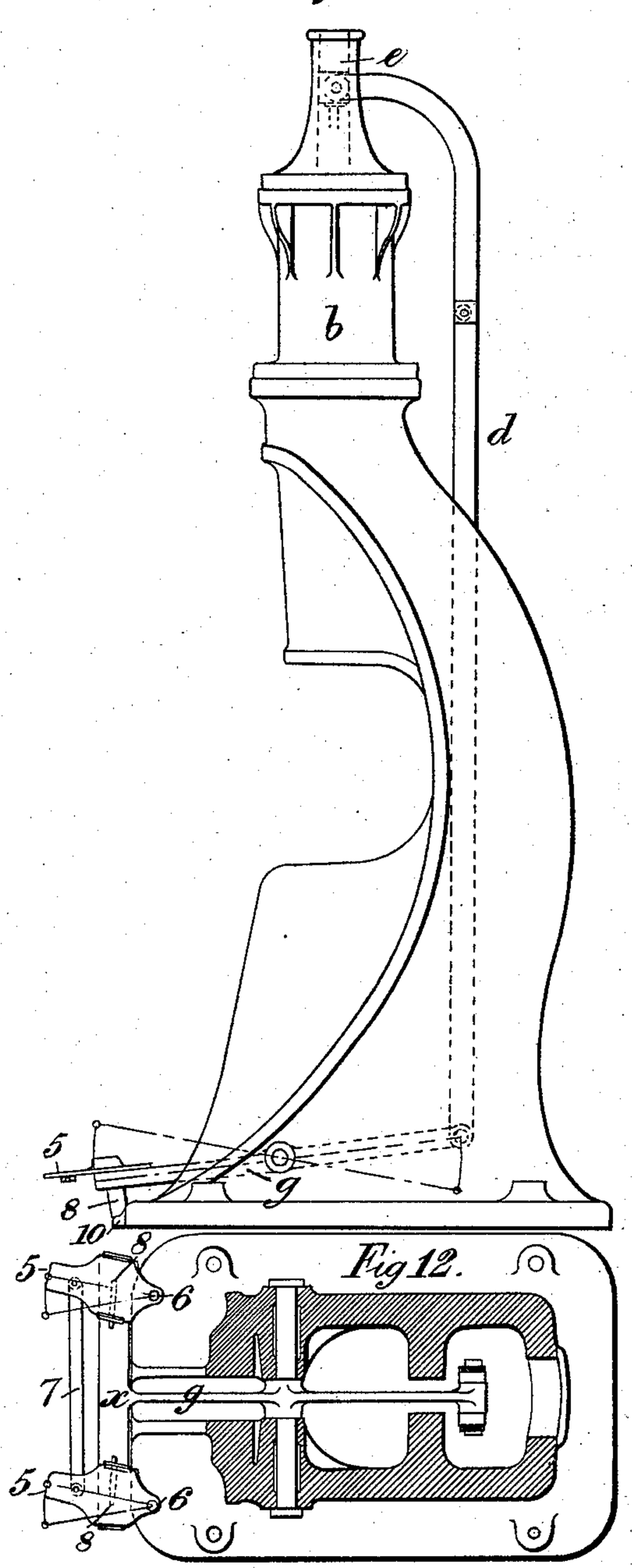

Fig 11.

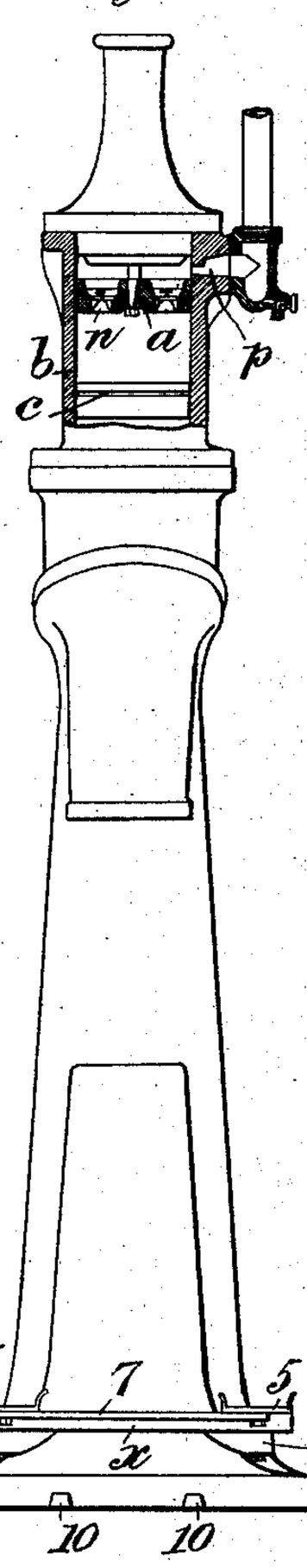

Fig 12.

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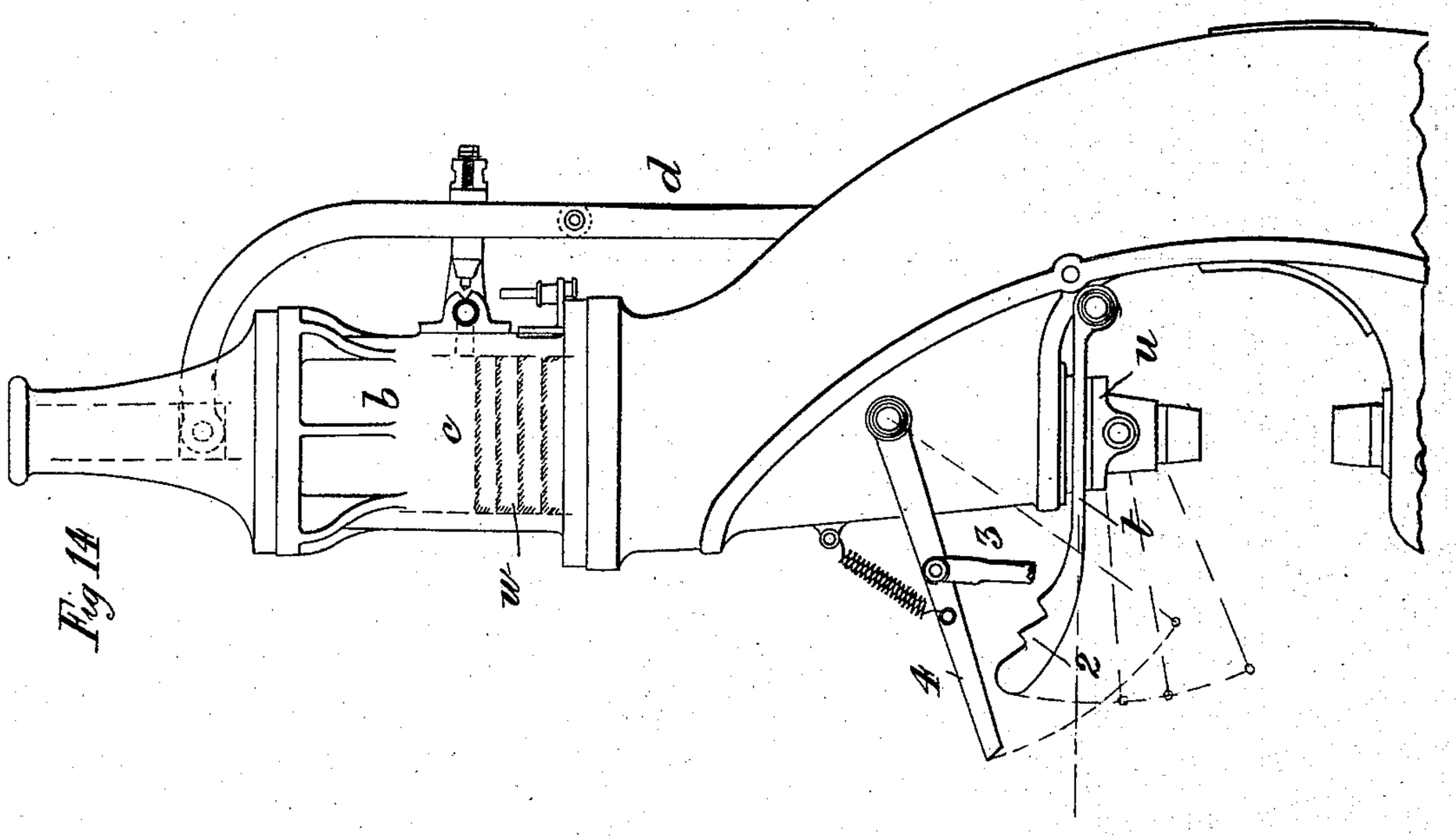

Fig 14

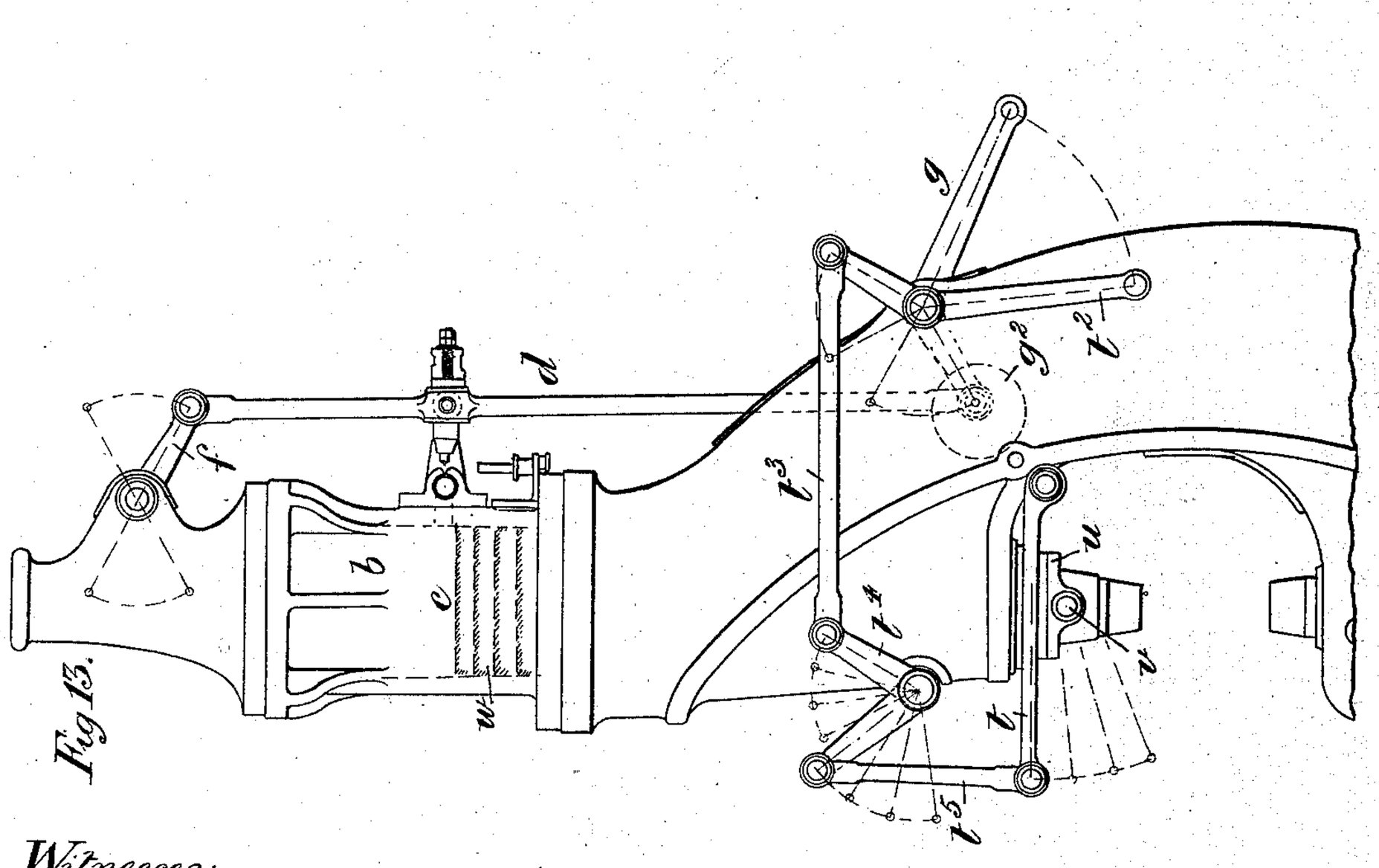

Fig 13.

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UNITED STATES PATENT OFFICE.

CHARLES WILLIAM PINKNEY, OF SMETHWICK, COUNTY OF STAFFORD, ENGLAND.

HAMMERING MACHINERY ACTUATED BY EXPLOSIVE GASEOUS MIXTURES.

SPECIFICATION forming part of Letters Patent No. 384,869, dated June 19, 1888.

Application filed September 26, 1887. Serial No. 250,744. (No model.) Patented in England February 8, 1887, No. 1,986.

To all whom it may concern:

Be it known that I, CHARLES WILLIAM PINKNEY, of Smethwick, in the county of Stafford, England, a subject of the Queen of Great Britain, have invented Improvements in Hammering, Stamping, Punching, and other Like Machinery Actuated by Explosive Gaseous Mixtures (for which I have made application for Letters Patent in Great Britain, No. 1,986, dated February 8, 1887,) of which the following is a specification.

My invention consists of the improvements hereinafter described, and illustrated in the accompanying drawings, in hammering, stamping, punching, and other like machinery actuated by explosive gaseous mixtures.

I will describe my invention in connection with a gas-hammer.

In gas-hammers as ordinarily constructed the strength of the blow is regulated by varying the point at which the gas-supply is cut off while the upper piston is making its charging stroke. When a blow of full strength is required, gas is admitted along with air during the whole of the charging stroke. When a blow of less than the full strength is required, the gas is admitted during only a portion of the charging stroke. This is effected by the action of a cam and lever so arranged that when the lever is in one position gas and air are admitted into the cylinder simultaneously, while in another position of the said lever air only is first taken into the cylinder and afterward a mixture of gas and air, the relative proportions depending on the required strength of the blow of the hammer. In order to facilitate the regulation of the blow of the hammer, I construct and arrange the driving parts in the following manner: When a blow of full strength is required, the piston is made to move through its full stroke, thereby taking into the cylinder a full charge of the detonating-mixture of gas and air. When a lighter blow is required, the stroke of the piston is correspondingly shortened and a smaller charge is consequently taken into the cylinder. In order to effect this the hand-wheel ordinarily employed is dispensed with and a long link connects the piston-rod guide of the charging-piston with a balanced lever below; or two levers may be employed, one connected to the piston-rod guide above and the other below the said levers, being connected by a link. In this case the combined weights of the lower lever and the link partly balance the piston. The lower lever is operated by hand and effects the working of the charging-piston, the stroke of the charging-piston being altered at will by the extent to which the operator moves the hand-lever. When the full blow of the hammer is required, the hand-lever is depressed through its whole range, and when a light blow is required the said lever is depressed only to a distance proportionate to the blow required. When a very light blow is required, a relief-valve is employed. This valve opens a communication between the explosion-space on the top of the charging-piston and a closed chamber of considerable capacity, and the explosion in part expends itself in compressing the air in the said chamber, and the force of the blow of the hammer is thereby diminished. The relief-valve may also communicate with the cylinder at any desired point, so that the hammer-piston will uncover the exhaust-passage while making its downstroke and discharge the contents of the cylinder at the desired time. By the action of the relief-valve the pressure upon the hammer-piston may be reduced to any desired extent, and the blow of the hammer consequently reduced in force but not in range. The method of shortening the stroke of the charging-piston may be used in combination with the method of relieving the pressure, or either arrangement may be used separately. The pressure of the explosion may also be relieved by checking the charging-piston slightly on its arriving at the termination of its upstroke, thereby preventing the exhaust-port from being completely covered. When the explosion occurs, part of the explosion is relieved through the valves in the charging-piston and by the exhaust-port. A stop can be applied by a lever, which stop will fix the exact point of termination of the travel of the upper piston. The force of the blow may also be relieved in the following manner: The hammer-piston, on making its upward stroke by

the action of its spring, may be prevented from rising to its usual height by one or two inches by allowing the check of the upstroke to be made by striking the usual buffer on a movable lever, which when in one position rests against the cylinder, but in another position may be moved down so as to meet the buffer-plate earlier. This lever is suitably connected so as to be under command of either the hand or the foot.

To enable the workman to work the hammer himself and still have both hands free to manipulate the forging, I employ foot-gear constructed as follows: The lower balanced lever described is brought sufficiently low to be actuated by the foot, and is so arranged that it passes to the front of the hammer. A wide treadle extending across the whole front of the hammer forms the end of the lever, and while the workman is standing on either side of the hammer he can easily place his foot on the treadle and move the lever and charging-piston at will. By pressing the treadle through its full range the maximum blow is obtained, and by limiting the range of movement of the treadle blows of less force are obtained, just as with the hand-lever. The relief-valve may also be put under the control of the foot. To effect this a lever with a palm on the end of it is so arranged that the palm is within range of the toe of the foot. When the foot has pressed the charging-lever to the bottom of its stroke, if the foot is turned aside slightly, the toe misses the palm of the relief-valve lever, and by restoring the straight position of the foot the toe strikes the relief-valve lever at the end of the stroke and opens the valve. When the explosion occurs, the blow is lessened in consequence of the diminished pressure. Two relief-valve levers and suitable connections may be provided, one on each side of the hammer-block, so that the relief-valve may be actuated from either side at will.

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

Figures 1 and 2 represent elevations (partly in vertical section) taken in planes at right angles to one another of a gas-hammer in which the blow is varied by regulating the position of the charging-piston in conjunction with a relief-valve and mechanism for working the same, together with minor parts constructed according to my invention. Fig. 3 represents in horizontal section a portion of the same, taken on the line A A, Fig. 1. In the gas-hammer represented in Figs. 1, 2, and 3 the position of the charging-piston is regulated and the relief-valve operated by hand. Fig. 4 is a side elevation, and Fig. 5 a sectional plan view, of a gas-hammer in which the charging-piston and relief-valve are operated by foot-gear. Fig. 6 illustrates a modification in the location of the relief-valve. Figs. 7 and 8 are partly-sectional side elevations at right angles to each other of an arrangement for relieving the pressure of the explosion. Fig. 9 is a horizontal section of the same. Fig. 10 is a side elevation; Fig. 11, a partly-sectional elevation at right angles thereto, and Fig. 12 a sectional plan of a modification in the mechanism for checking the upward motion of the charging-piston. Fig. 13 is a side elevation illustrating an arrangement for relieving the force of the blow of the hammer by checking the upward motion of the hammer-piston. Fig. 14 is a modification of the same.

a is the charging-piston working in the cylinder *b*, and *c* is the hammer-piston, also working in the said cylinder *b*, the charge of the detonating-mixture of gas and air being taken into the cylinder *b* and between the two pistions *a* and *c* from the pipe c^2. The charge of the gaseous mixture is drawn into the cylinder *b* by the upstroke of the charging-piston *a*, and by regulating the stroke of the said piston *a* in the manner hereinafter described the amount of the charge taken into the said cylinder *b*, and consequently the blow of the hammer, may be varied. The explosion of the charge gives the downstroke to the hammer-piston *c* and hammer carried by it, the said hammer-piston and hammer being raised after the hammer has made its blow by the double telescopic or conical ribbon or band spring c^3 c^3 around the piston-rod of the hammer-piston, the said spring being compressed by the downstroke of the hammer-piston. The small end of each part of the conical spring c^3 takes an abutment against the collar c^4 at the middle of the piston-rod, the large end of the upper part of the spring taking an abutment against the under side of the piston *c*, and the large end of the lower part of the spring taking an abutment against the hammer-frame, as seen in Fig. 1. As the hammer descends the double conical spring c^3 is compressed by its convolutions sliding one within another. *p* is the exhaust-port for taking away the spent or exploded gases, the said port *p* opening into the explosion-space *k* (see Fig. 2) at the top of the charging-piston *a*.

In order to regulate the stroke of the charging-piston *a*, I apply to it the following hand-worked mechanism: *d* is a long link jointed at top to the lever *f*, the inner end of which lever is connected to the piston-rod guide *e* of the charging-piston *a*. The lower end of the link *d* is jointed to the short arm of the cranked weighted lever $g\,g^2$. The combined weights of the weight g^2 on the lever *g* and the link *d* partly balances the charging-piston *a*. By means of the hand-lever *g* the working of the charging-piston *a* is effected, the stroke of the charging-piston *a* being altered at will by the extent to which the operator moves the said hand-lever *g* through the arcs or portions of the arcs indicated in the drawings.

When a blow of full strength is required in the hammer, the short arm of the hand-lever *g* is depressed through its whole range by rais-

ing the long arm of the said hand-lever, and the piston *a* takes the position represented in Fig. 1; and when a light blow is required the said short arm of the hand-lever *g* is depressed only to a distance proportionate to the blow required. The position of the charging-piston *a* in its cylinder *b* is thereby changed and a less charge of the detonating gaseous mixture is taken into the cylinder.

I will now describe the relief-valve and parts connected with it, which relief-valve is used when a very light blow is required.

h (see Fig. 2) is the relief-valve opening and closing the passage k^2, the said valve being worked by the hand lever h^2 and rod h^3. The passage k^2 is in communication with the explosion-space *k* at the top of the charging-piston *a*. The passage k^2, in which the relief-valve *h* is situated, is in communication by means of the vertical pipe *m* with a closed or air-cushion chamber *l* in the upright of the hammer. (See Fig. 1 and the horizontal section Fig. 3.) By opening the valve *h* by means of its hand-lever h^2 part of the spent gases from the explosion-space *k* passes by the pipes k^2 and *m* to the closed or cushion chamber *l*, compressing the air in the said chamber, and the force of the blow is thereby diminished. By the action of the relief-valve *h* the pressure upon the hammer-piston *c* may be reduced to any desired extent, and the blow of the hammer consequently reduced in force but not in range; or the relief-valve *h* may be applied to about the middle or other part of the cylinder *b* instead of to the top of the cylinder, as described, and represented in Fig. 2. This modification is represented in elevation and vertical section in Fig. 6, where k^2 is the passage in which the relief-valve is situated, in communication by the vertical pipe *m* with the closed or cushion chamber *l*, into which the spent gases pass. In this arrangement the passage k^2 is uncovered by the descent of the hammer-piston *c*, and as the gases pass direct to the chamber *l* the heating of the charging-piston *a* by the heated gases is avoided.

Fig. 4 represents in side elevation, and Fig. 5 in plan, a gas hammer in which the charging-piston and relief-valve are worked by foot-gear instead of by hand. *d* is the long link for working the charging-piston *a*. The upper end of the said link in this arrangement is connected directly to the piston-rod guide instead of through a lever. *g* is the balanced lever situated at the base of the hammer, so that it can be worked by the foot. The said lever *g* passes to the front of the hammer, and has at its front end a wide treadle, *x*, which extends across the whole front of the hammer, as seen in Fig. 5. By this arrangement the workman standing on either side of the hammer can place his foot on the treadle *x* and move the lever *g*, rod *d*, and charging-piston *a* at will.

By pressing the treadle *x* fully down the charging-piston *a* is raised to its full extent in the cylinder *b*, and the maximum blow is obtained, and by limiting the range of the movement of the treadle *x* through portions of the arc indicated in Fig. 4 blows of less force may be obtained. The mechanism for working the relief-valve *h* by the foot consists of the two side levers, *y y*, connected together by the solid axis z^2 passing through the tubular shaft *z*, carrying the lever *g* of the charging-piston mechanism. One of the side levers *y* is jointed to a rod, y^3, connected to the relief-valve rod h^3 in the tube *m*. Each side lever *y* is furnished with a palm, y^2, each palm being so situated that it is within range of the toe of the attendant pressing the treadle *x* at either side of the hammer. When the foot has pressed the charging-piston *a* to the bottom of its stroke, if the foot be turned slightly aside, it misses the palm y^2 of the relief-valve lever *y*, and by restoring the straight position of the foot the toe strikes the relief valve lever at the end of the stroke and opens the relief-valve *h*. When the explosion occurs, the blow is lessened in consequence of the diminished pressure. Instead of using two relief-valve levers, as represented, one only may be used; but I prefer the arrangement represented in the drawings.

Figs. 7 and 8 represent side elevations, partly in section, taken at right angles to one another, and Fig. 9 a horizontal section, of the arrangement for relieving the pressure of the explosion by preventing the exhaust-port being completely closed by the charging-piston on the latter reaching the termination of its upstroke. The parts in this arrangement by which portion of the explosion is relieved are the valves in the charging-piston *a* and by the exhaust-port *p*. The checking of the charging-piston *a*, so as to fix the exact point of the termination of its upward motion, is effected by the stop *q* on the fixed framing of the hammer, the said stop *q* limiting the motion of the weighted lever *g*, by which the charging-piston is adjusted through the link *d* and lever *f*, as before described. In order still further to limit the motion of the said lever *g*, a wedge, *r*, sliding upon the stop *q* to a greater or less extent diminishes more or less the range through which the said lever *g* can be moved. The wedge *r* is operated by the small lever *s*, the action of which will be understood by reference to Figs. 8 and 9; or the stop-and-wedge arrangement for checking the upward motion of the charging-piston may be operated by the foot. In this case the parts are modified in the manner represented in the side elevations taken at right angles to one another, Figs. 10 and 11, and in the plan Fig. 12.

g is the foot-lever, and *x* the treadle of the same, for operating the charging-piston *a* as described with respect to Figs. 4 and 5. Over the said treadle *x* of the foot-lever *g* are shoes 5 5, swiveling on the treadle-lever of the hammer at 6 6, and connected together by the rod 7, upon which the foot bears on pressing down

the treadle *x*. On the underside of the shoes 5 5 are wedges 8 8, and on the base of the hammer are stops 10 10. When the shoes 5 5 are in their normal or straight position, as represented in Fig. 11, the pressing down of the treadle *x* is not interfered with, and consequently the upward stroke of the charging-piston is not altered, as the wedges 8 8 escape past and do not strike the stops 10 10. When, however, the shoes 5 5 are turned aside, as illustrated in Fig. 12, the wedges 8 8 are brought over and strike the stops 10 10, as seen in Fig. 10, and the descent of the lever *g* is thereby limited and the charging-piston *a* consequently checked in its upward stroke.

Fig. 13 represents inside elevation an arrangement for relieving the force of the blow of the hammer by checking the upward motion of the hammer-piston *c*. *u* is the buffer on the hammer-piston, the said buffer swiveling on the center *v*. *t* is the lever pressing upon the said buffer *u*. The lever *t* is jointed to the frame of the hammer, and can be depressed more or less, so as to meet the swiveling buffer *u* on the rising hammer piston at any desired point, and thereby check the upward stroke of the hammer-piston. The dotted lines at *w* indicate different positions of the hammer-piston *c* under the influence of the lever *t*. The lever *t* is worked by the hand-lever t^2 through the link t^3, cranked lever t^4, and link t^5.

In working the checking-lever *t* for limiting the ascent of the hammer-piston by means of the foot the parts are modified in the manner illustrated in Fig. 14. *u* is the swiveling buffer, and *t* the lever pressed against the said buffer. The lever *t* is notched at 2. Above the buffer-lever *t* is a pawl-lever, 4, drawn upward by a spring and connected by the rod 3 to a foot-lever having a palm similar to that represented in Figs. 4 and 5. On the descent of the hammer-piston *c* the notched lever *t* is depressed, and by placing the foot on the palm of the foot-lever the connecting-rod 3 depresses the pawl-lever 4 and its end engages in one or other of the notches at 2 in the lever *t*, thereby limiting the height to which the said lever and hammer-piston can rise so long as the foot is pressed upon the palm of the foot-lever.

The application of my improvements to stamping, punching, and other like machinery actuated by explosive gaseous mixtures differs in no essential respect from their application to gas-hammers, as hereinbefore described.

The mixing apparatus, igniting devices, and exhaust-valves of the piston form no part of the present invention, and as a full description of said parts may be found in English Patents No. 4,050 of 1880 and No. 1,886 of 1885, they need not be further explained here.

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

1. In hammering, stamping, punching, and like machinery actuated by explosive gaseous mixtures, the combination of a cylinder to receive the explosive mixture, a charging-piston and a hammer-piston located in said cylinder, and means, substantially as described, for adjusting the stroke of the charging-piston to vary the charge of the gaseous mixture drawn into the cylinder, and thereby regulate the blow of the hammer-piston, substantially as described.

2. In a gas-hammer or like machine, the combination of the cylinder *b*, charging-piston *a*, hammer-piston *c*, relief-valve *h*, and cushion-chamber *l*, substantially as described.

3. In a gas-hammer or like machine, the combination of the cylinder *b*, charging-piston *a*, guide *e*, lever *f*, link *d*, and weighted lever *g* g^2, substantially as described.

4. In a gas-hammer or like machine, the combination of the cylinder *b*, charging-piston *a*, hammer-piston *c*, exhaust-port *p*, stop *q*, lever *f*, link *d*, and weighted lever *g*, substantially as described.

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