T. SCOTT-KING & W. NORRIS.

POWER HAMMER.

APPLICATION FILED SEPT. 4, 1906.

942,756

Patented Dec. 7, 1909.

5 SHEETS—SHEET 1.

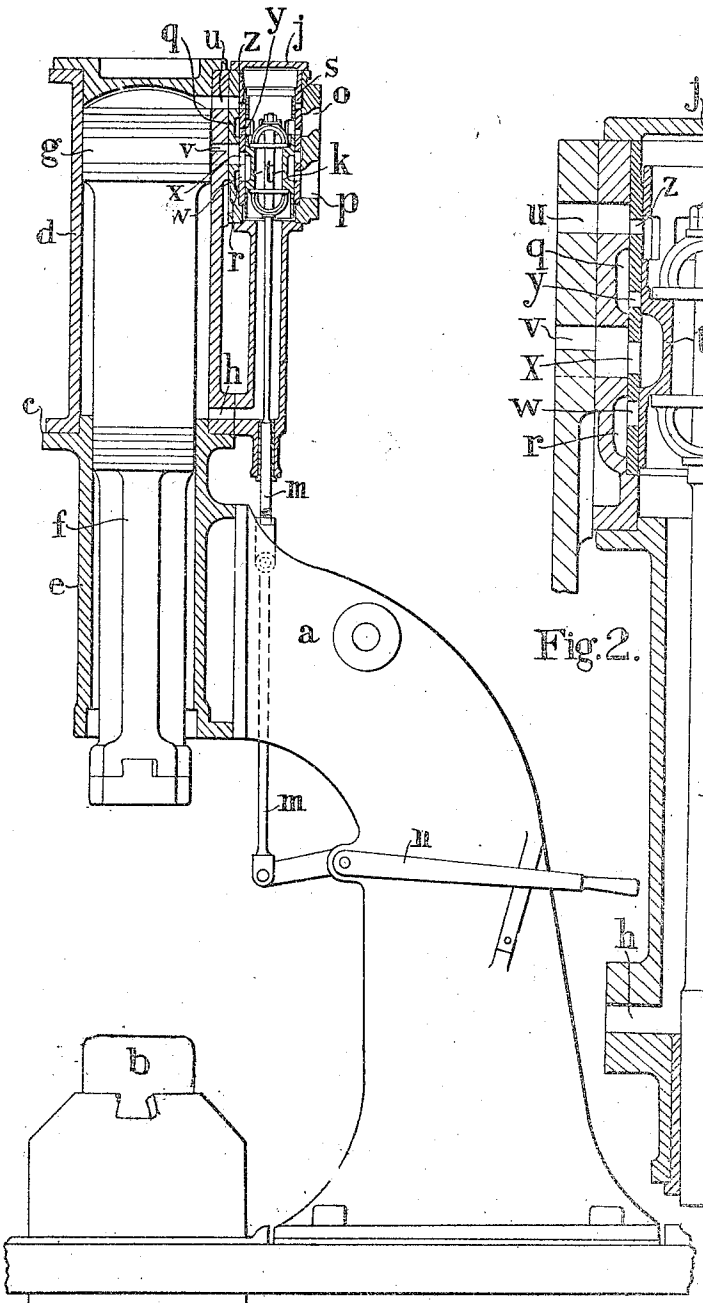

Fig. 1.

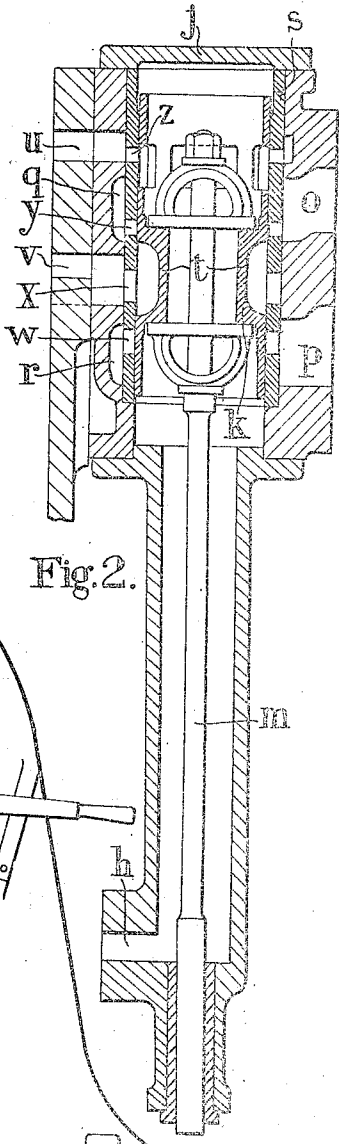

Fig. 2.

Witnesses
Margaret H. Mattern
Kate Sturrif.

Inventors,
Thomas Scott-King & William Norris
by Albert Mattern

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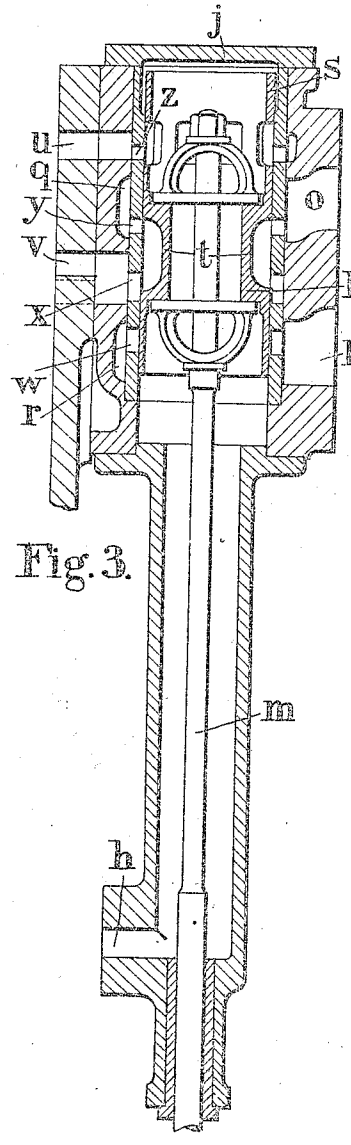

Fig. 3.

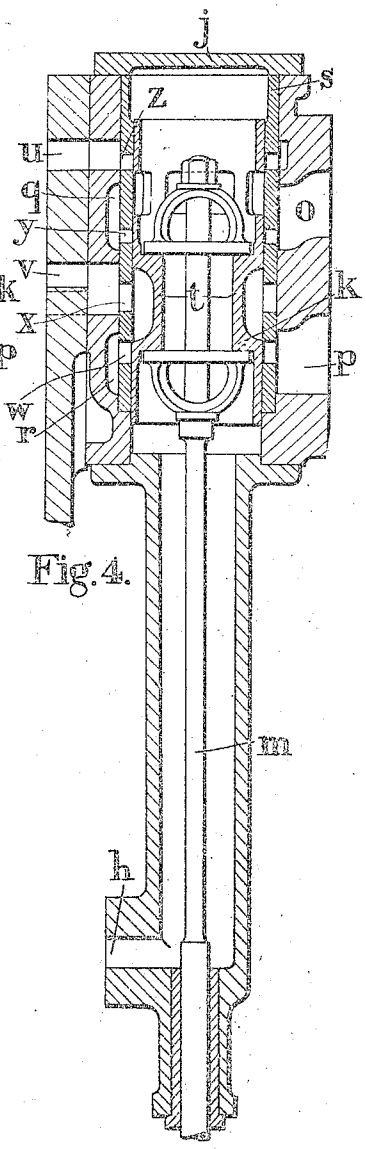

Fig. 4.

Witnesses
Margaret H. Nathan
Kate Starry.

Inventors:
Thomas Scott-King & William Norris
by Allen & Nathan Atty

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5 SHEETS—SHEET 3.

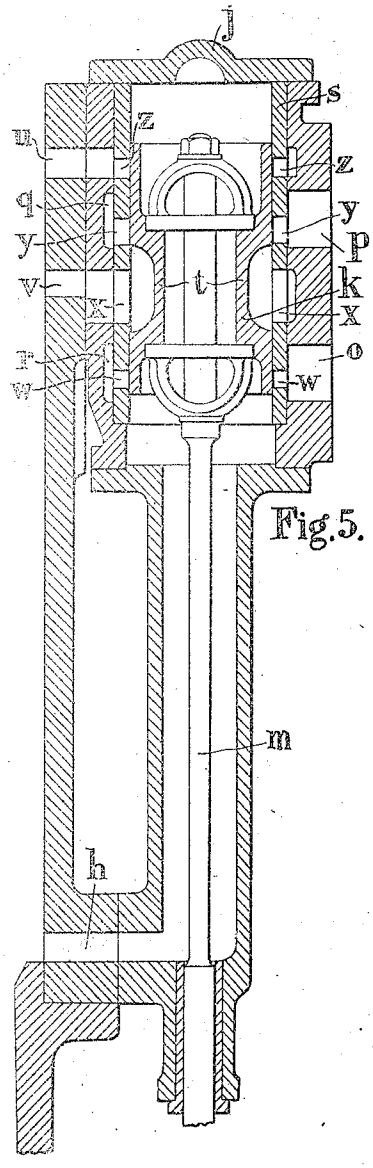

Fig. 5.

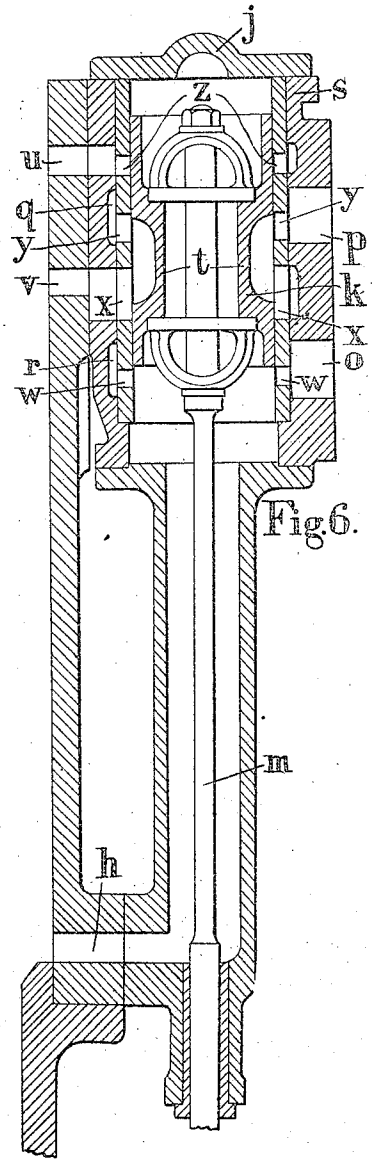

Fig. 6.

Witnesses
Margaret H. Nathan
Kate Starry.

Inventors.
Thomas Scott-King & William Norris.
by Albert Nathan Atty

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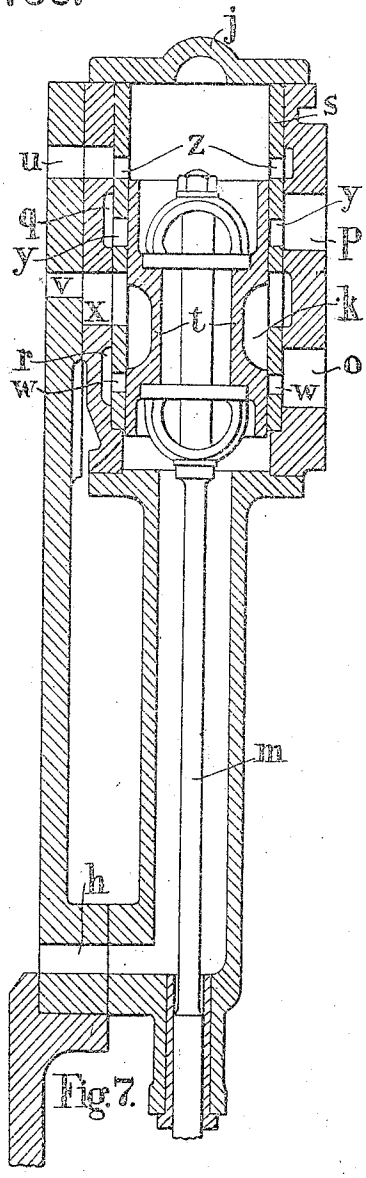

Fig. 7.

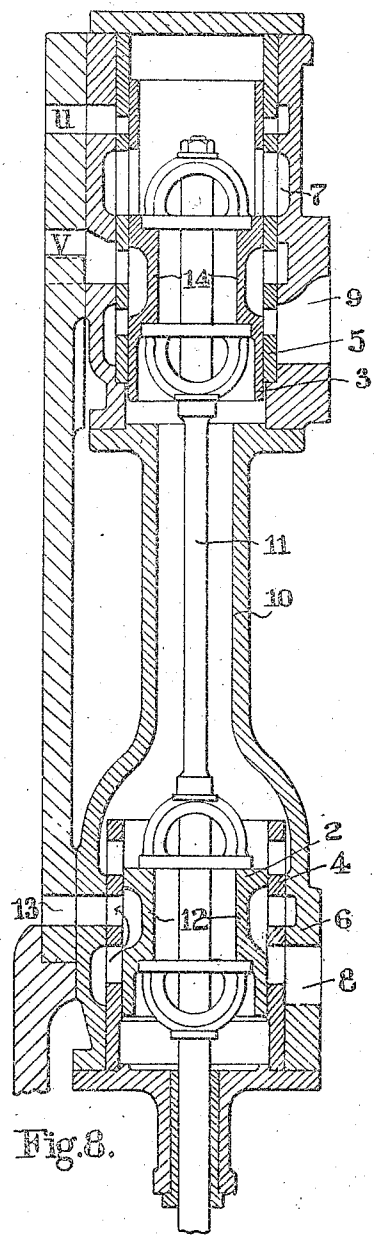

Fig. 8.

Witnesses
Margaret H. Nathan
Kate Gurney.

Inventors
Thomas Scott-King and William Norris
by Albert G. Nathan
Attorney

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5 SHEETS—SHEET 5.

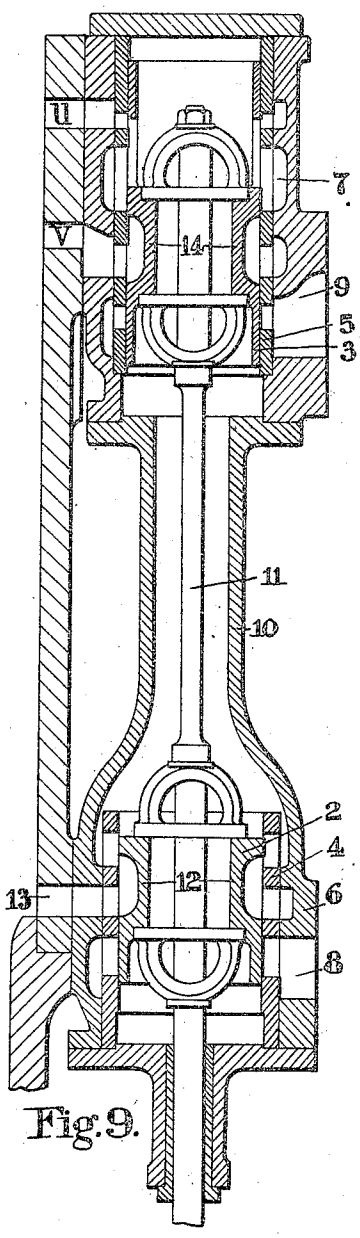

Fig. 9.

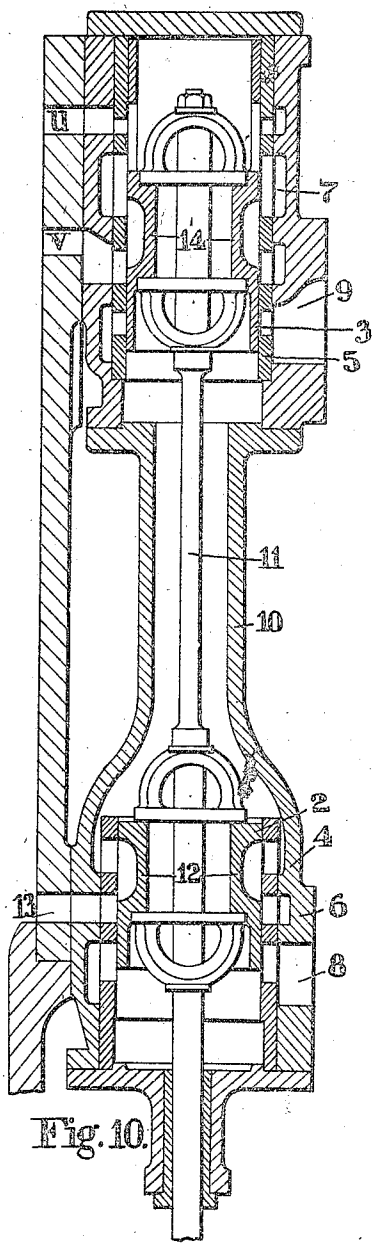

Fig. 10.

Witnesses.
Margaret H. Nathan
Kate Stacy.

Inventors
Thomas Scott-King & William Norris
By Albert G. Nathan Atty

UNITED STATES PATENT OFFICE.

THOMAS SCOTT-KING, OF PENARTH, CARDIFF, AND WILLIAM NORRIS, OF BLACKPOOL, ENGLAND.

POWER-HAMMER.

942,756. Specification of Letters Patent. Patented Dec. 7, 1909.

Application filed September 4, 1906. Serial No. 333,180

To all whom it may concern:

Be it known that we, THOMAS SCOTT-KING, M. I. M. E., of 43 Westbourne road, Penarth, Cardiff, in the county of Glamorgan, Wales, and WILLIAM NORRIS, of 20 Osborne road, Blackpool, Lancashire, England, subjects of the King of Great Britain and Ireland, have invented certain new and useful Improvements in Power-Hammers, of which the following is a specification.

This invention relates to power hammers as used for forging work. Such hammers are required to give blows of varying length, force and period, and in so doing great waste of working fluid has occurred and the maximum efficiency has not been attained.

The object of the present invention is to utilize the expansive force of the working fluid more economically than hitherto, while at the same time all varieties of blows common to the art may be obtained. To this end we cause the fluid to act expansively in the striking stroke, while the degree of force in the blow may be increased by supplementing the fluid acting expansively with high pressure fluid or the force of the blows may be diminished by increasing the amount of the expansion.

The accompanying drawings forming part of this specification illustrate three convenient constructions, in which:

Figure 1 is an elevation of a pneumatic hammer according to one form of this invention the valve being shown in section. Figs. 2, 3 and 4 are sectional views showing the valve in various positions. Fig. 5 illustrates a modified form of valve while Figs. 6 and 7 illustrate it in various positions. Fig. 8 shows a further modification in which two valve casings are provided while, Figs. 9 and 10 illustrate different positions of the form of valve shown in Fig. 8.

In carrying the invention into effect according to the form shown in Fig. 1 the hammer frame, *a*, is of the general form well known as applied to steam hammers while the anvil, *b*, is firmly founded. The hammer cylinder, *c*, is of considerable length and is bored out to two diameters the upper part, *d*, of larger diameter constitutes a working cylinder while the lower part, *e*, acts as a guide to the hammer tup, *f*. In the upper part there works a piston, *g*, formed on the tup, *f*, so that below this piston and around the tup there is formed an annular space. Into this annular space near the lower end of the working cylinder, *d*, there enters a pipe, *h*, leading from a valve chamber, *j*, in which works a piston valve, *k*, adapted to control the supply of air to the working cylinder and operated in any convenient way by hand. We have illustrated the valve as operated by the usual mechanism employed in connection with steam hammers, that is by means of a rod, *m*, and operating hand lever, *n*. The valve chamber, *j*, is provided with an inlet, *o*, and an exhaust passage, *p*, both of which passages lead to annular recesses, *q* and *r*, respectively formed around the valve chamber. A liner, *s*, having ports cut therein is provided within the valve chamber while the valve, *k*, itself works within the liner and is provided with a waist or part, *t*, of smaller diameter.

The working cylinder, *d*, is provided near its upper end with two ports, *u* and *v*, the port, *u*, acting as an admission port while the port, *v*, acts as an exhaust. Four sets of ports, *w*, *x*, *y*, *z*, are provided in the liner. The ports, *w*, allow the exhaust air to pass from the space around the waisted or narrow portion, *t*, of the valve, *k*, to the exhaust air outlet, *p*; the ports *x*, allow the exhaust air to pass from the cylinder, *d*, through the passage, *v*, to the waisted portion, *t*, of the valve. The ports, *y*, permit the air to pass from the air inlet, *o*, through the ports in the valve, *k*, to the interior of the valve chamber from which the compressed air passes through the pipe, *h*, to the annular space around the tup, *f*, for the purpose of lifting.

The operation of this hammer will now be described with reference to Figs. 1 to 4, Figs. 2 to 4 showing the valve in various positions.

In Fig. 1 the valve, *k*, is in position for lifting the tup. Air flows through the inlet, *o*, ports, *y*, valve chamber, *j*, and passage, *h*, to the annular chamber around the tup while the space above the tup is in communication with the atmosphere through the port, *v*, to the cylinder, *d*, ports, *x* and *w* in the liner, *s*, and exhaust passage, *p*. This is the case till the piston, *g*, on the tup covers the port, *v*, after which the air above the piston has no outlet and in consequence forms a cushion. It will be understood that by holding the valve, *k*, in the position shown in Fig. 1 the hammer tup is held up.

Fig. 2 shows the position of the valve for striking ordinary blows. The valve, *k*, is moved upward until the ports, *z*, are uncovered and placed in communication with the valve chamber, simultaneously with which the exhaust ports, *w*, are closed. The high pressure air in the annular space around the tup, *f*, and in the clearance spaces in the valve chamber now expands into the space above the piston, *g*, the effective working area of which is the difference between the whole cross sectional area of the cylinder, *d*, and the area of the annular space. The tup is thus driven downward and the force of the blow given depends not only upon the mean effective pressure of the air on the piston, *g*, but also upon the weight of the tup.

Fig. 3 shows the valve in position for striking dead blows or giving a squeeze to the material on the anvil. To do this the valve, *k*, is moved upward to its extreme position so as to place the high pressure air inlet in communication with the waisted portion, *t*, of the valve, *k*. The air from the underside of the tup piston which was used to raise the tup, passes through the passage, *h*, and the interior of the valve and enters the tup chamber above the tup piston by means of the passage, *u*, through holes in the valve which register with the ports, *z*, thus giving the piston an initial movement. As soon as the tup has moved sufficient distance to uncover the passage, *c*, air at full pressure is admitted through the ports, *y*, *x* and passage, *v*, in series and a maximum dead blow is effected, and at the end of the stroke of the tup a cramping or squeezing action can be obtained. It will be seen that at first the air from below the tup piston acts expansively to move the tup but as soon as the passage, *c*, is uncovered the pressure above and below the tup piston is equalized and the blow obtained by means of the larger area on the upper face of the tup piston.

Fig. 4 is a view showing the position of the valve for holding the tup in any required position. In this position the valve, *k*, closes the ports, *w*, *y*, and *z*, whereby the air above and below the tup piston is inclosed and there is no motion of the tup.

In Figs. 5 to 7 a form of the invention is shown in which no provision is made for striking dead blows. High pressure air in this form enters through the lower opening, *o*, while the exhaust takes place through the upper opening *p*. Fig. 5 shows the valve in neutral position for holding the hammer tup, *f*, in any part of its travel. The ports *w*, *y*, and *z* in the liner are all closed.

Fig. 6 shows the valve in position for lifting or holding up the tup. High pressure air enters at, *o*, and passes through the passage, *h*, to the annular space around the tup, *f*, and below the piston, *g*.

Fig. 7 shows the valve in position for striking a blow. The valve is moved downward to uncover the port, *u*, leading to the top of the working cylinder, *d*, whereby the air in the annular space around the tup and in the clearance spaces in the valve chamber expands into the working cylinder, *d*.

Figs. 8 to 10 show a modified form of the invention. In this form the valve is arranged in two parts 2 and 3 working in liners 4 and 5 placed in valve boxes 6 and 7 connected by a pipe 10 through which passes the valve rod, 11. High pressure air is admitted through the opening 8 while the exhaust takes place through the opening 9. The arrangement of the hammer cylinder is the same as described with reference to Fig. 1.

Fig. 8 shows a valve in position for lifting or holding up the tup. High pressure air flows in through inlet 8 around the waisted portion 12 of the valve 2 into the annular space around the tup through the port 13 as shown by the arrow in Fig. 8. The upper end of the piston is meanwhile open to the atmosphere through port, *v*, waisted portion 14 of the valve 13 and exhaust passage 9.

Fig. 9 shows the position of the valve for striking a blow. The valve is moved upward until the annular space below the piston, *g*, is placed in communication with the upper end of the working cylinder, *d*, through the passage, 13, waisted portion 12, pipe 10, and passage, *u*, as shown by the arrows in Fig. 9. The exhaust passage is of course closed.

Fig. 10 shows the position of valve for striking a dead blow. The valve is moved upward to its extreme position so as to establish communication between the upper end of the working cylinder, *d*, and the high pressure air inlet 8. The annular space below the piston, *g*, being also connected to the high pressure air inlet so that as before the effective area is the difference between the cross section of the working cylinder, *d*, and the annular space around the tup or in other words the effective working area pressing the tup down is equal to the cross section of the tup.

Although we have described our invention as applied to a vertical form of hammer it should be understood that it may be conveniently applied to other forms. Also by manipulating the valve any degree of blow may be given; thus it will be seen that if the hammer be raised for only a portion of a stroke the effect of the pressure upon the tup may be readily varied. In this way by controlling the point of cut off of the compressed air to the annular chamber the desired strength of blow may be delivered. It will also be understood that any other modifications may be made to the form of valve

employed without departing from this invention, which has for its main object to produce a multiple expansion power hammer so as to render the operation of these more economical and efficient.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In combination with the anvil and frame of a pneumatic hammer, a tup and tup chamber, a piston on said tup and working in said chamber, a valve chamber and a valve therein, high pressure air and exhaust connections to said valve chamber, a passage opening into the lower end of said tup chamber whereby high pressure air can act to raise the tup, a passage through the valve in communication with said passage opening at the lower end of the tup chamber and also in communication with a passage opening into the upper end of said chamber, whereby the air used to raise the tup can act expansively on said tup to strike a blow and another passage opening to the upper end of said chamber acting in conjunction with said valve to admit high pressure air direct whereby the force of the blow is increased and a cramping action is obtained.

2. In combination with the anvil and frame of a pneumatic hammer, a tup and tup chamber, a piston on said tup and working in said chamber, a valve chamber, a ported cylindrical liner of the same diameter throughout its entire length within said valve chamber, high pressure air and exhaust connections to said chamber and opposite different sets of ports in the liner, a passage opening into the lower end of tup chamber and a passage opening into the upper end of said chamber whereby the air used to raise the tup can act expansively on said tup to strike a blow and said upper passage acting in conjunction with said valve to admit high pressure air direct whereby the force of the blow is increased and a cramping action is obtained.

3. In a pneumatic hammer, a tup and tup chamber, a valve and valve chamber having a ported cylinder liner, high pressure and exhaust connections opposite different sets of ports in the liner, two connections leading from the valve chamber to the upper end of hammer cylinder, a connection leading to the lower end of said cylinder, a cylindrical valve having a waist or narrow portion and arranged to work within the liner.

4. In combination with the anvil and frame of a pneumatic hammer, a tup and tup chamber, a piston on said tup and working in said chamber, a guide cylinder placed below an opening from said tup chamber in which guide cylinder the tup is a working fit, a valve chamber and a valve therein, high pressure air and exhaust connections to said valve chamber, a passage opening into the lower end of said tup chamber whereby high pressure air can act to raise the tup, a passage through the valve in communication with said passage opening at the lower end of the tup chamber and also in communication with a passage opening into the upper end of said chamber, whereby the air used to raise the tup can act expansively on said tup to strike a blow and another passage opening to the upper end of said chamber acting in conjunction with said valve to admit high pressure air direct whereby the force of the blow is increased and a cramping action is obtained.

5. In combination with the anvil and frame of a pneumatic hammer, a tup and tup chamber, a piston on said tup and working in said chamber, a valve chamber, a ported cylindrical liner of the same diameter throughout its entire length within said valve chamber, high pressure air and exhaust connections to said chamber and opposite different sets of ports in the liner, a passage opening into the lower end of tup chamber, a valve chamber, and a valve therein, high pressure air and exhaust connections to said valve chamber, a passage opening into the lower end of said tup chamber whereby high pressure air can act to raise the tup, a passage through the valve in communication with said passage opening at the lower end of the tup chamber and also in communication with a passage opening into the upper end of said chamber, whereby the air used to raise the tup can act expansively on said tup to strike a blow and another passage opening to the upper end of said chamber acting in conjunction with said valve to admit high pressure air direct whereby the force of the blow is increased and a cramping action is obtained.

6. In combination with an anvil and frame of a pneumatic hammer, a tup and tup chamber, a piston on said tup and working in said chamber, a valve chamber and a valve therein, high pressure air and exhaust connections to said valve chamber, a cylindrical liner of uniform diameter throughout its entire length within said valve chamber, a passage opening into the lower end of tup chamber, whereby high pressure air can act to raise the tup, a passage through the valve in communication with said passage opening into the lower end of said tup chamber, a passage through said valve, a passage through said liner and a passage opening into the upper end of said tup chamber whereby the air used to raise the tup can act expansively on said tup to strike a blow and a passage opening to the upper end of said tup chamber acting in conjunc-

tion with said valve to admit high pressure air direct whereby the force of the blow is increased and a cramping action is obtained.

7. In combination with an anvil and frame of a pneumatic hammer, a tup and tup chamber, a piston on said tup and working in said chamber, a valve chamber and a valve therein, high pressure air and exhaust connections to said valve chamber, a cylindrical liner of uniform diameter throughout its entire length within said valve chamber, a passage opening into the lower end of tup chamber, whereby high pressure air can act to raise the tup, a passage through the valve in communication with said passage opening into the lower end of said tup chamber, a passage through said valve, a passage through said liner and a passage opening into the upper end of said tup chamber whereby the air used to raise the tup can act expansively on said tup to strike a blow, a passage through said liner in communication with the high pressure air connection, a waisted or narrow portion of said valve mid-way between its extremities, this narrow portion communicating with the passage in the liner opening to high pressure air connections, a passage through said liner in communication with the waisted portion of said valve, a passage opening into the upper end of said tup chamber in communication with the passage in said liner opening into the waisted portion of said valve whereby high pressure air is admitted direct above the tup piston to increase the force of the blow and to obtain a cramping action.

In testimony whereof we affix our signatures in the presence of two witnesses.

THOMAS SCOTT-KING.
WILLIAM NORRIS.

Witnesses:
BERNARD POOLE,
SYDNEY HOBBS.