H. A. BROCKWAY.

PNEUMATIC HAMMER.

APPLICATION FILED SEPT. 14, 1908.

924,531.

Patented June 8, 1909.

2 SHEETS SHEET 1.

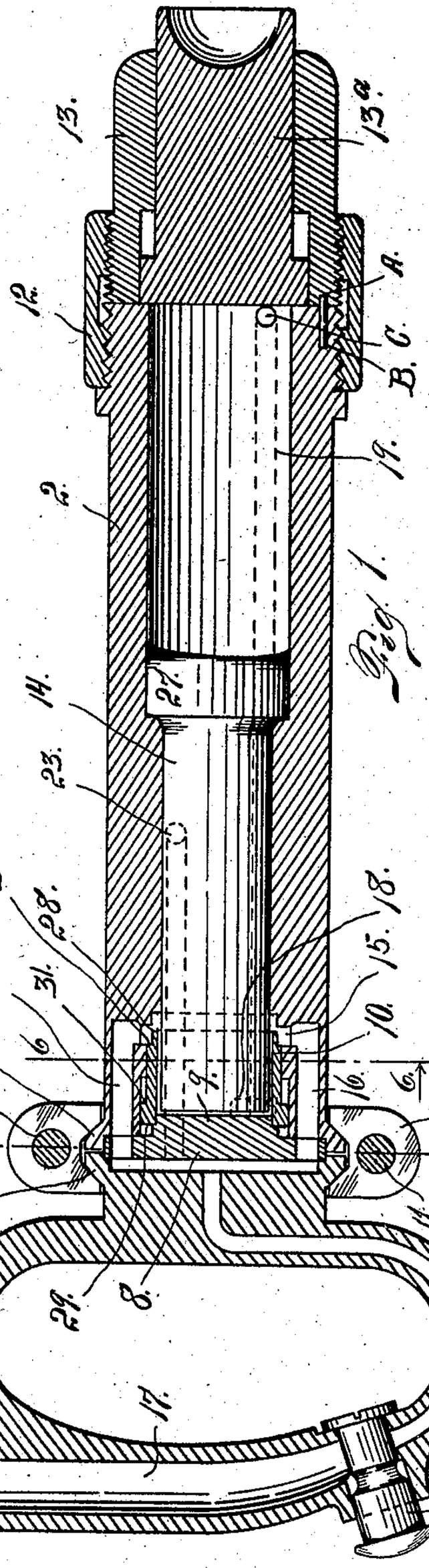

Fig. 1.

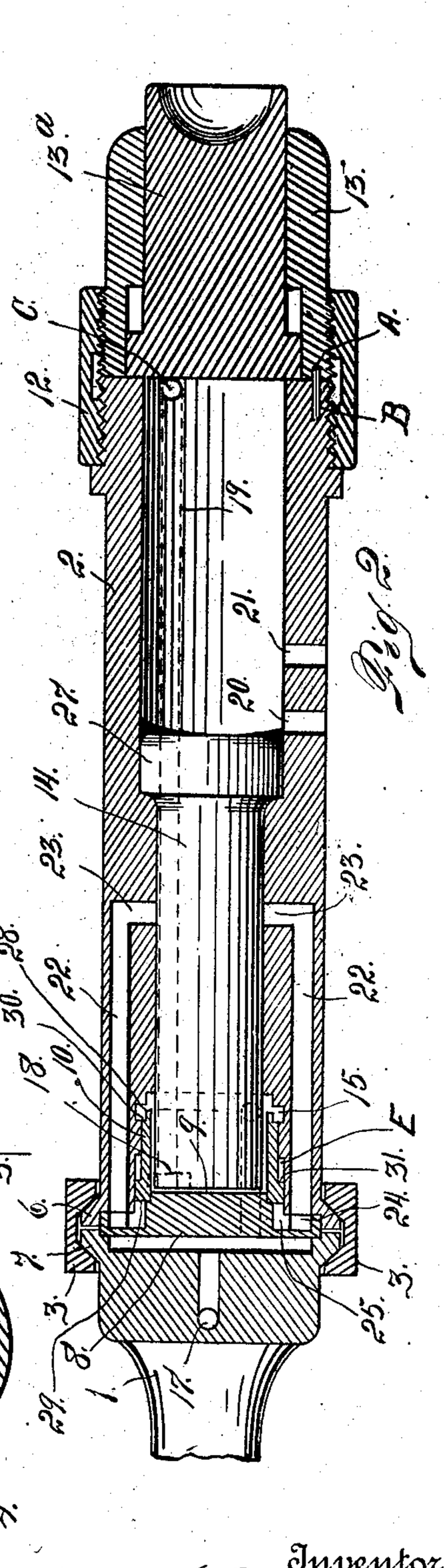

Fig. 2.

Witnesses

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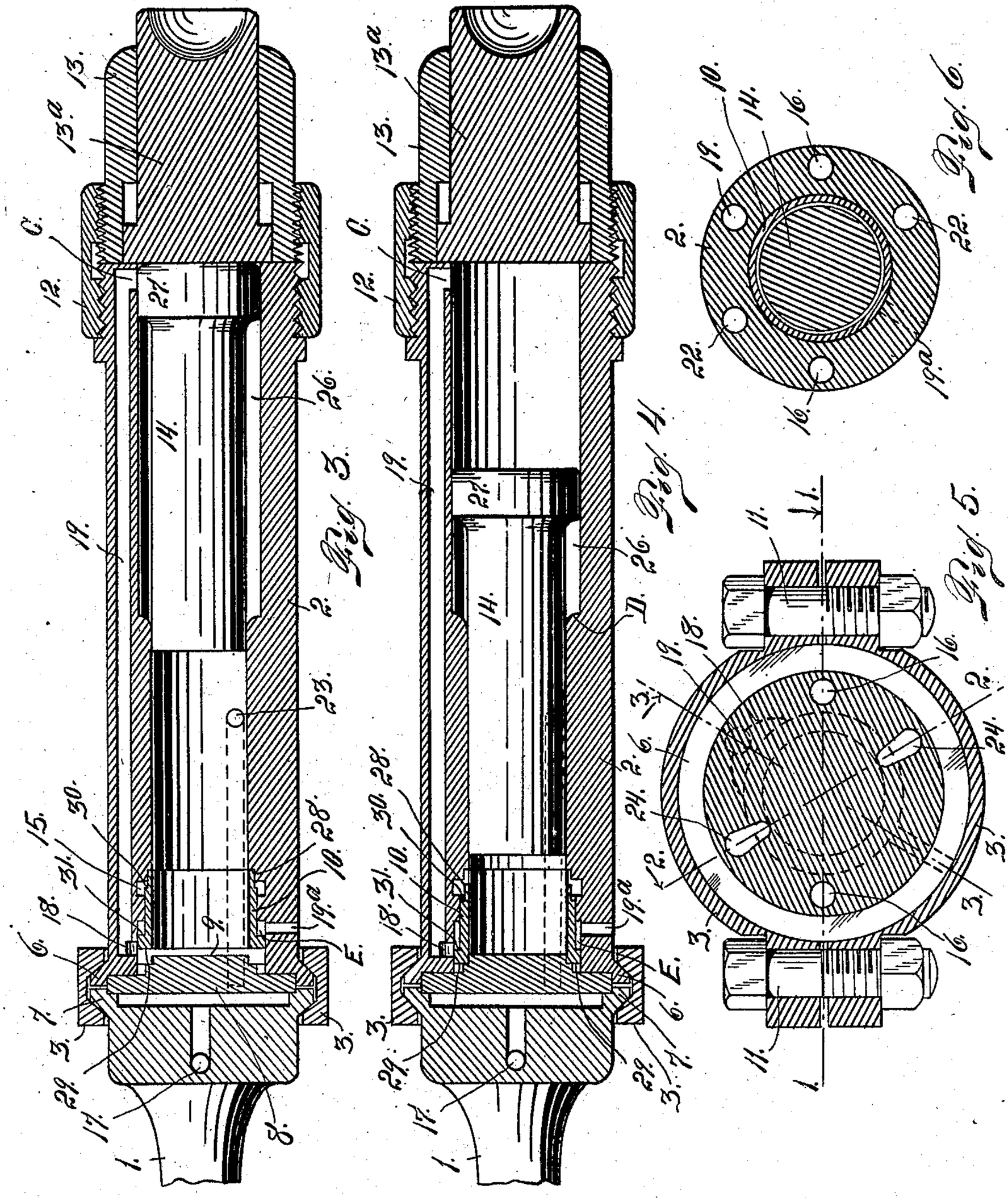

Witnesses

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UNITED STATES PATENT OFFICE.

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PNEUMATIC HAMMER.

No. 924,531. Specification of Letters Patent. Patented June 8, 1909.

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To all whom it may concern:

Be it known that I, HERBERT A. BROCKWAY, a citizen of the United States, residing at the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Pneumatic Hammers; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to that class of pneumatic tools known as piston-hammers, which are employed for various purposes, as chipping, calking, riveting and for drilling holes.

My improved device consists of a tool of this class wherein the air used to produce the impact stroke, is afterward admitted to a larger area of the piston thereby causing the return stroke. This feature is very important since it makes a great saving in the amount of motive fluid used.

Another feature of my invention consists of improved means for gradually stopping the return stroke and gradually starting the impact or forward stroke, thereby reducing the vibration and jar to which a tool of this kind is subject.

Still another feature consists of a valve arrangement whereby the air in front of the piston must practically all escape before the valve will open. When the valve does open, the air pressure in front of the piston has become reduced to a minimum, thereby offering but little resistance to the force of the blow.

In tools of this class it is very difficult to maintain the parts in their proper places owing to the constant vibration; and another feature of my invention consists of means to prevent the handle from coming loose from the cylinder. This feature is also adapted for use for securing other parts that it may be necessary to hold together. I have two constructions for overcoming this difficulty, either of which is effective.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing in which is illustrated an embodiment thereof.

In this drawing, Figure 1 is a longitudinal section of my improved tool, taken on the line 1—1 Fig. 5. Fig. 2 is a similar section taken on the line 2—2 Fig. 5. Fig. 3 is a section taken on the line 3—3 Fig. 5, the hammer being shown in the forward position and the valve in a corresponding position, being shifted forwardly from the position shown in Figs. 1 and 2. Fig. 4 is also a section taken on the line 3—3 Fig. 5 showing the valve and hammer in different relative positions from those shown in Fig. 3. Fig. 5 is a cross section taken on the line 5—5 Fig. 1. Fig. 6 is a similar section taken on the line 6—6 Fig. 1. All the sections are viewed in the directions indicated by the arrows adjacent the lines upon which they are taken.

The same reference characters indicate the same parts in all the views.

Let the numeral 1 represent the handle which is secured to the cylinder 2 by a clamp-band 3. The handle is equipped with a throttle valve 4 and a nipple 5, to which the air hose not shown may be attached. The cylinder 2 is provided with an annular shoulder 6 having a tapered face on one side. In like manner the handle is provided with a similar shoulder 7. Intermediate the handle 1 and the cylinder 2, is a cap 8 having a projection 9 around which the valve 10 snugly fits. The shoulder at the rear extremity of the projection 10 forms a seat for the rear extremity of the valve when the latter is in the open position or in a position to allow the live motive fluid to enter the piston chamber to impart the forward or impact stroke to the tool.

Around the projections 6 and 7 on the handle and cylinder, is fitted the clamp-band 3 which is shown in two sections (see Fig. 3) and which is interiorly bored out to correspond with the tapered faces on the shoulders 6 and 7. Bolts 11 are inserted in apertured ears or lugs with which the band members are provided, whereby these members are drawn and bound together. Jam-nuts are placed on the bolts as a further precaution against the possible loosening of the connected parts. This construction constitutes one of my features for tightly securing the members of the mechanism in the assembled relation.

The forward end of the cylinder 2 is threaded to receive a sleeve 12. A retaining piece 13 is also threaded to receive the opposite end of the said sleeve. The cylinder has a less number of threads per inch than the retaining piece. I prefer that

there shall be eight threads per inch on the cylinder and ten threads per inch on the retaining piece. The sleeve is correspondingly threaded. In applying the sleeve 12 it is screwed onto the cylinder almost as far as it will go and then the retaining piece 13 is screwed in until a recess A therein is engaged by a dowel pin B, which is inserted in the forward extremity of the cylinder. Then by screwing the sleeve 12 still farther on, the parts are brought tightly together, owing to the fact that the sleeve travels onto the cylinder faster than it leaves the retaining piece. The successful use of this means of holding the parts together, need not be confined to the parts shown, but could also be used in place of the clamp-band 3; and likewise the last named band could be used in place of the sleeve 12.

The rear end of the cylinder is counterbored to three different diameters to receive the valve 10, whose inside diameter is slightly in excess of the outside diameter of the piston 14. At the end of the second counter-bore is a circumferential groove 15 formed in the wall of the cylinder, which is in communication with a source of motive fluid supply, through the medium of passages 16 and 17, the former being formed in the wall of the cylinder and the latter in the handle of the device. Near the middle of the first valve counter-bore of the cylinder is a port 18 which is in communication with the rear extremity of a longitudinal passage 19 formed in the wall of the cylinder and whose forward extremity is in communication with the forward end of the piston chamber by means of a port C. Near the front end of the first counter-bore is a port 19[a] (see Figs. 3 and 4) formed in the wall of the cylinder and leading to the atmosphere for exhaust purposes.

The cylinder 2 is bored to form a piston chamber of two diameters, the two portions of the chamber being about equal in length, the front portion being the larger. In this chamber is located the piston 14, having a head 27 which closely fits the larger portion of the cylinder, while the body of the piston or the portion in the rear of the head, closely fits the smaller diameter of the chamber. Near the rear of the larger bore of the cylinder, the latter is provided with a relief port 20 and an exhaust port 21. The rearward portion of the cylinder is also provided with passages 22 whose forward extremities communicate with the piston chamber by ports 23, and whose rear extremities communicate by means of ports 24, with a space 25 between the valve and the cap 8.

The operation of the device as thus far described is as follows. Assuming that the parts are in the relative positions illustrated in Fig. 1, the valve 10 is opened by virtue of the pressure of the motive fluid on the smaller area 30 thereof, and the said fluid is admitted through the passages 17 and 16 and the groove 15, to the narrow space between the bore of the valve 10 and the outside diameter of the piston. The air entering through this space, passes to the rear of the piston hammer and drives the latter forwardly with an accelerated motion which will be hereinafter described more in detail. The motive fluid in front of the piston escapes during the forward stroke of the latter, through the port C, the passage 19, the port 18, and the port 19[a] to the atmosphere. As the piston 14 advances, a space 26 (see Figs. 3 and 4) is created behind the head 27 of the piston. By means of the ports 20 and 21 the vacuum in the rear of the head is relieved. These ports serve as auxiliary exhaust ports as hereinafter more fully explained.

During the forward stroke of the piston the valve 10 is held open by the pressure of the live motive fluid on the front end 28 thereof, until the piston passes the cylinder ports 23, when air is admitted through these ports and the passages 22 and 24 to the larger area 29 of the valve 10, when the latter is shifted to the forward position, or that illustrated in Fig. 3. The air imprisoned in the cylinder behind the piston, now escapes across the larger area 29 of the valve 10, by way of the port 18, the passage 19 and the port C to the front end of the piston chamber, coming in contact with the larger area of the piston or with the front surface of the piston-head 27, and the pressure upon this head, being greater than that upon the opposite end of the piston, causes the piston to commence the return or rearward movement. During this movement the head 27 of the piston intercepts and cuts off the ports 20 and 21 from communication with the rear part of the annular space 26, whereby an air cushion is formed between the head of the piston and the shoulder located between the two diameters of the piston chamber, whereby the rear extremity of the piston is prevented from hitting the cap 8, thus obviating the vibration incident to such contact.

As the head 27 of the piston 14 passes beyond the ports 21 and 20, these ports become auxiliary or premature exhaust ports, since the pressure in the front end of the cylinder exhausts through these ports; and the pressure on the larger area 29 of the valve 10 becomes reduced by virtue of the communication formed by the port C and the passage 19 of the port 18, with the result that the pressure of the live fluid on the smaller area 30 of the valve 10, re-asserts itself and opens the valve or shifts it to its rearward position, after which the operations heretofore described are repeated.

By arranging the valve so that the piston 14 will pass into it, leaving a small space be-

tween the bore of the valve and the piston, I am able to throttle the initial admission of air through the groove 15, thereby greatly reducing the vibration to which the tool is subject. This tends to start the piston at a slow rate of speed, which gives the air in front of the piston an opportunity to escape. As the piston advances beyond the bore of the valve and the groove 15 opens into the piston chamber, motive fluid is freely admitted behind the piston resulting in the striking of a hard blow.

In further explanation of the operation of the device, assuming that the parts are in the position shown in Fig. 1 of the drawing, it may be stated that the air in front of the piston is exhausting through the port C, the passage 19 and the ports 18 and 19ª, the air in this case escaping through the space E in front of the shoulder 31 of the valve. This tends to steady and assist the air pressure on the front end of the valve to maintain the latter in its position. It should also be stated that the air escapes through the ports 20 and 21 until they are cut off by the head 27 of the piston, in which event they become relief ports to relieve the vacuum which would otherwise be formed in the space 26.

By arranging the areas 29 and 30 of the valve in the proper relative proportion, I am able to exhaust practically all of the air from the front end of the piston chamber through the ports 20 and 21, before the valve will open to start the piston on its forward stroke, inasmuch as the pressure on the area 29 of the valve is the same per square inch as that in the front end of the piston chamber. Hence, it is obvious that the pressure on the smaller area 30 of the valve will not assert itself and open the valve until the pressure on the front part of the piston chamber has become sufficiently reduced to properly relieve the pressure on the area 29 of the valve, for the purpose stated. This feature I consider very important to the operation of my device in the most efficient manner.

I am aware that various means have heretofore been employed for relieving the vibration to which machines of this character are subject. I am also aware that numerous machines have been produced wherein the piston is adapted to enter or pass into the bore of the valve, but as far as I am aware, I am the first to utilize a piston passing into the bore of the valve as a means of reducing the vibrations to which a machine of this character is subject. The other constructions to which I refer in which the piston enters or passes into the bore of the valve, use this feature as a means of economizing space and reducing the length of the machine.

It may further facilitate the perfect understanding of the device, to state that the front side of the shoulder 31 of the valve, is always open to the exhaust by way of the port 19ª (see Figs. 3 and 4). The port 18 communicating with the passage 19 as heretofore explained, is of the same width as the shoulder 31 of the valve 10 and is so arranged that when the valve is in the closed position, or at its forward limit of movement (see Fig. 3) half of the port 18 communicates with the space behind the piston while the other half of the same port is covered or blinded by the shoulder 31 of the valve.

When the valve is in the position shown in Fig. 1 half of the port 18 communicates with the exhaust port 19ª, while the other half is blinded. Hence, the port 18 and the passage 19 serve as transfer passages, when the valve is in the position shown in Fig. 3, transferring motive fluid imprisoned behind the piston to the larger front area thereof, thus propelling the piston rearwardly until after the ports 20 and 21 are passed, when the portion of the air in front of the piston will escape. The valve then shifts to the closed position or that shown in Figs. 1, 2 and 4. The port 18 then communicates with the exhaust port 19ª and any air remaining in front of the piston, after the latter has cut off the ports 20 and 21 by its forward movement, escapes through the passage 19, the port 18, the space E and the exhaust port 19ª. At the same time air is being admitted through the groove 15 to drive the piston forwardly.

My improved device may also be termed a compound piston-hammer.

By using two passages 22 and two ports 23 located on opposite sides of the cylinder, the action of the valve is improved, since the motive fluid is admitted equally on both sides thereof, and any tendency of the valve to bind or stick is prevented.

In further explanation of the means for reducing the vibrations of the machine, I wish to state that as the piston nears the end of its return stroke, the head 27 cuts off the port 20 thereby creating a cushion in the space 26, in the rear of the piston head. This tends to gradually stop the return stroke, and by means of the contracted space between the bore of the valve and the piston, the initial admission of air to the rear of the piston is reduced until the piston has passed out of the bore of the valve when the air is freely admitted through the groove 15. This tends to bring the piston to a gradual rest at the end of the return stroke, which in turn tends to give the air in front of the piston a better opportunity to escape, since the piston is retained in a comparative state of rest at the termination of the rearward stroke.

Another feature of my invention consists in the provision of means whereby the piston ceases to reciprocate when the tool is removed from the work. The rivet-set 13ª which is illustrated in the drawing may, of course, be displaced and a chisel, calking

device, a drill or other tool, substituted. When motive fluid is turned into the machine by accident or otherwise, and the rivet-set or other tool is not held against the work, the piston 14 will drive forwardly until the rear end thereof passes under the larger part of the cylinder bore. The head 27 of the piston will also pass beyond the end of the passage 19 and no air will come in contact with the front head. In this event, all motive fluid admitted to the tool will pass to the exhaust through the ports 20 and 21. Some may pass back through passages 19 and the port 18 and thence to the exhaust port 19[a]. Hence, the piston will not reciprocate unless the tool is held in proper position to do its work.

Having thus described my invention, what I claim is:

1. In a pneumatic hammer, the combination of a piston chamber having two different diameters, the larger of which is forward of the smaller, a piston having corresponding diameters fitted therein, a valve, the wall of the piston chamber having ports and passages controlled by said valve to admit a quantity of motive fluid to the rear of said piston and subsequently admit the said fluid to the front of said piston, the wall of the piston chamber having an open air port communicating with the larger part of the piston chamber and which the said piston cuts off prior to the completion of the rearward stroke, thereby forming an air cushion behind the larger part of the said piston.

2. In a pneumatic hammer, the combination of a piston chamber, a piston therein having different effective pressure areas, a valve located in a chamber at the rear of said piston chamber and having pressure surfaces of different area, the said valve being adapted to admit a quantity of motive fluid to the smaller area of said piston and to subsequently admit the same fluid to the larger area of said piston, the larger area of the said valve being subject to the motive fluid passing from the smaller to larger area of said piston.

3. In a pneumatic tool, the combination of a piston chamber, a piston therein having different effective pressure areas, a hollow valve located in a chamber at the rear of said piston chamber, a main inlet passage controlled by one end of said valve, a passage controlled by the opposite end of said valve, said last named passage terminating in the forward part of said piston chamber, said valve being adapted to admit a quantity of motive fluid to the smaller area of said piston and to subsequently admit the said quantity of motive fluid to the larger area of said piston.

4. A pneumatic hammer comprising a piston chamber of two different diameters, the larger of which is foremost, a piston having corresponding diameters fitted therein, a reciprocating valve having pressure surfaces of different areas against the smaller of which motive fluid constantly acts to move the valve in one direction, and to the larger of which motive fluid is intermittently admitted to move the valve in the opposite direction, and means whereby the motive fluid which passes from the rear of the piston to the front of the piston shall pass to the larger area of the said valve.

5. A pneumatic hammer comprising a piston chamber with two different diameters, the larger being foremost, a piston having an enlarged head fitting the larger diameter of the chamber, a valve having pressure surfaces of different areas, the wall of the piston chamber having ports and passages controlled by said valve to admit a quantity of motive fluid to the smaller area of the said piston, while in one position, and to subsequently admit the same portion of the motive fluid to the larger area of the piston when in the other position, and means whereby the said motive fluid shall pass to the larger area of the said valve.

6. A tool of the class described comprising a piston chamber of two different diameters, the larger of which is foremost, a piston having corresponding diameters fitted therein, a reciprocating valve having pressure surfaces of different areas, the smaller of which is constantly acted upon by the motive fluid and the larger of which is intermittently acted upon by the motive fluid passing from the rearward to the forward end of the piston chamber.

7. A pneumatic hammer comprising a casing having a piston chamber, a piston therein, the said piston having different effective pressure areas, a valve having pressure surfaces of different areas, the smaller of which is constantly acted upon by the motive fluid and the larger of which is intermittently acted upon by the motive fluid which passes from the smaller to the larger area of the said piston.

8. A pneumatic hammer comprising a piston chamber, a piston therein, a reciprocating valve having pressure surfaces of different areas, the smaller of which is constantly acted upon by the motive fluid and the larger of which is intermittently acted upon by the motive fluid which passes from the rearward to the forward end of the piston chamber, and means to open the forward end of the said chamber to the exhaust, prior to the completion of the rearward stroke.

9. A tool of the class described comprising a piston chamber, of two different diameters, the larger of which is forward of the smaller, a piston having corresponding diameters fitted therein, a reciprocating valve having pressure surfaces of different areas, the smaller of which is constantly acted upon by

the motive fluid and the larger of which is intermittently acted upon by the motive fluid which passes from the rearward to the forward end of the piston chamber, and means to open the forward end of the piston chamber to the exhaust prior to the completion of the rearward stroke of the piston.

10. A tool of the class described comprising a chamber having two different diameters, a piston having corresponding diameters fitting the said chamber, a valve located in the rear of the piston chamber and into which the piston passes during the completion of the return stroke, the said valve having pressure surfaces of different areas, the smaller of which is constantly acted upon by the motive fluid and the larger of which is intermittently acted upon by the motive fluid, which passes from the rearward to the forward end of the piston chamber.

11. A pneumatic hammer comprising a piston chamber, a valve located in the rear end thereof, the wall of the piston chamber having a main inlet passage near the forward end of the said valve and a piston adapted to enter the said valve and partially cut off the admission of motive fluid from the said inlet passage.

12. A pneumatic hammer comprising a piston chamber, a valve located at the rear end thereof, whose bore slightly exceeds that of the piston chamber, the wall of the said chamber having a main inlet passage near the forward end of the said valve and a piston adapted to enter the said valve bore, thereby forming a space between the piston and the bore of the said valve, the said space being adapted to reduce the admission of motive fluid from the said inlet passage.

13. A pneumatic hammer comprising a piston chamber, a valve located at the rear end thereof, and having a bore which slightly exceeds that of the piston chamber, the wall of the piston chamber having a main inlet passage near the forward end of the valve and a piston adapted to enter the said valve bore to reduce the initial admission of the motive fluid from the said inlet passage, until it passes out of the said valve bore.

14. A tool of the class described comprising a piston chamber, a valve located at the rear end thereof and provided with a bore, which slightly exceeds that of the piston chamber, the wall of the said piston chamber having a main inlet passage controlled by the front end of the said valve, and a piston which enters the said valve bore, thereby forming a space between the piston and the valve, the said space being of less cross-sectional area than that of the main inlet passage.

15. A pneumatic tool comprising a piston chamber, a valve located at the rear end thereof, and having a bore slightly in excess of that of the chamber, the said valve having pressure surfaces of different areas, the smaller of which is constantly acted upon by the motive fluid to move the valve in one direction, the larger of which is intermittently acted upon by the motive fluid to move the valve in the opposite direction, the wall of the piston chamber having an inlet passage controlled by the front end of the said valve and a piston which enters the said valve bore and reduces the initial admission of motive fluid.

16. A pneumatic tool comprising a piston chamber, a differential-pressure-area valve located at the rear end of the chamber, and having a bore which exceeds that of the piston chamber, the wall of the chamber having a main inlet passage controlled by the front end of the valve, and a piston which enters the valve bore during the completion of its return stroke, and reduces the initial admission of motive fluid from the said inlet passage until it passes out of the said valve bore during its forward stroke.

17. A pneumatic hammer comprising a piston chamber of two different diameters, the larger of which is foremost, a piston having corresponding diameters fitting the said chamber, a valve located at the rear end of the said piston chamber and having a bore which slightly exceeds that of the piston chamber and into which the piston passes during the completion of its rearward stroke, the wall of the piston chamber having a port leading to the exhaust in the part of the piston chamber having the larger diameter, the said port being so located that the piston will cut it off prior to the completion of its rearward stroke.

18. In a pneumatic tool, a piston chamber having two different compartments, the larger being foremost, a piston having an enlarged head fitted therein, a valve which controls the movements of said piston, the wall of the piston chamber having a passage leading from said valve and terminating in a port opening into the forward end of the said chamber, said port being located so that the head of said piston will traverse and open said port to the rear of said head when the piston exceeds its normal forward limit of movement.

19. A device of the class described comprising a piston chamber of two different diameters, the larger of which is foremost, a piston having corresponding diameters fitted for reciprocation therein, a valve to control the movements of said piston and means to direct all motive fluid to the rear of said piston, when it exceeds its normal limit of movement.

20. A tool of the class described comprising a piston chamber of two different diameters, the larger of which is foremost, a piston having corresponding diameters fitted for reciprocation in the said chamber, a valve to

control the said movements of said piston, and means to create an air cushion behind the larger part of said piston prior to the completion of its rearward stroke.

21. A pneumatic tool comprising a piston chamber of two different diameters, the larger of which is foremost, a piston having a head larger than the body thereof, fitted for reciprocation in the larger diameter of the said chamber, a valve to control the movements of the said piston, the wall of the chamber having an opening leading to the exhaust and communicating with the larger part of said chamber, the said opening being intercepted by the head of the piston prior to the completion of its rearward stroke, said opening subsequently forming an exhaust port for the front end of the piston chamber thereby closing the rear of the larger part of the piston chamber to the exhaust.

22. A tool of the class described comprising a piston chamber of two different diameters, the larger of which is foremost, a piston having a head larger than the body thereof, fitted to reciprocate in the said chamber, a valve to control the movements of said piston, the wall of the chamber having an opening leading to the exhaust in the rearward part of the larger portion of the said chamber, a secondary opening leading to the exhaust located forward of the first named opening, the head of the piston being adapted to intercept and uncover the said openings whereby they are caused to communicate with the front end of the piston chamber, prior to the completion of the rearward stroke, thereby forming an air cushion behind the head of the said piston.

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

HERBERT A. BROCKWAY.

Witnesses:

A. EBERT O'BRIEN,

ALODIA HUTCHISON.