

April 3, 1928.

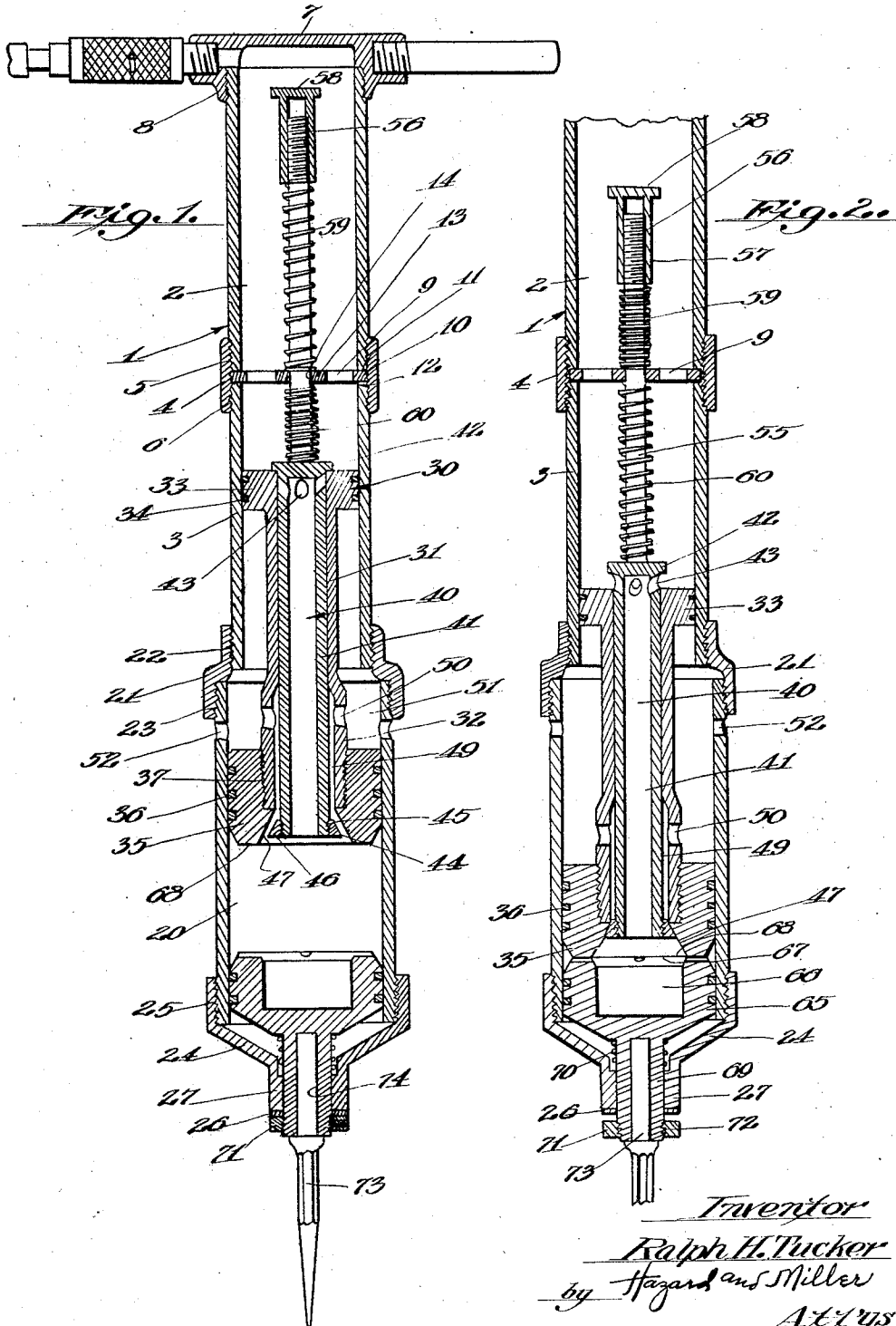
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PNEUMATIC HAMMER

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2 Sheets-Sheet 1



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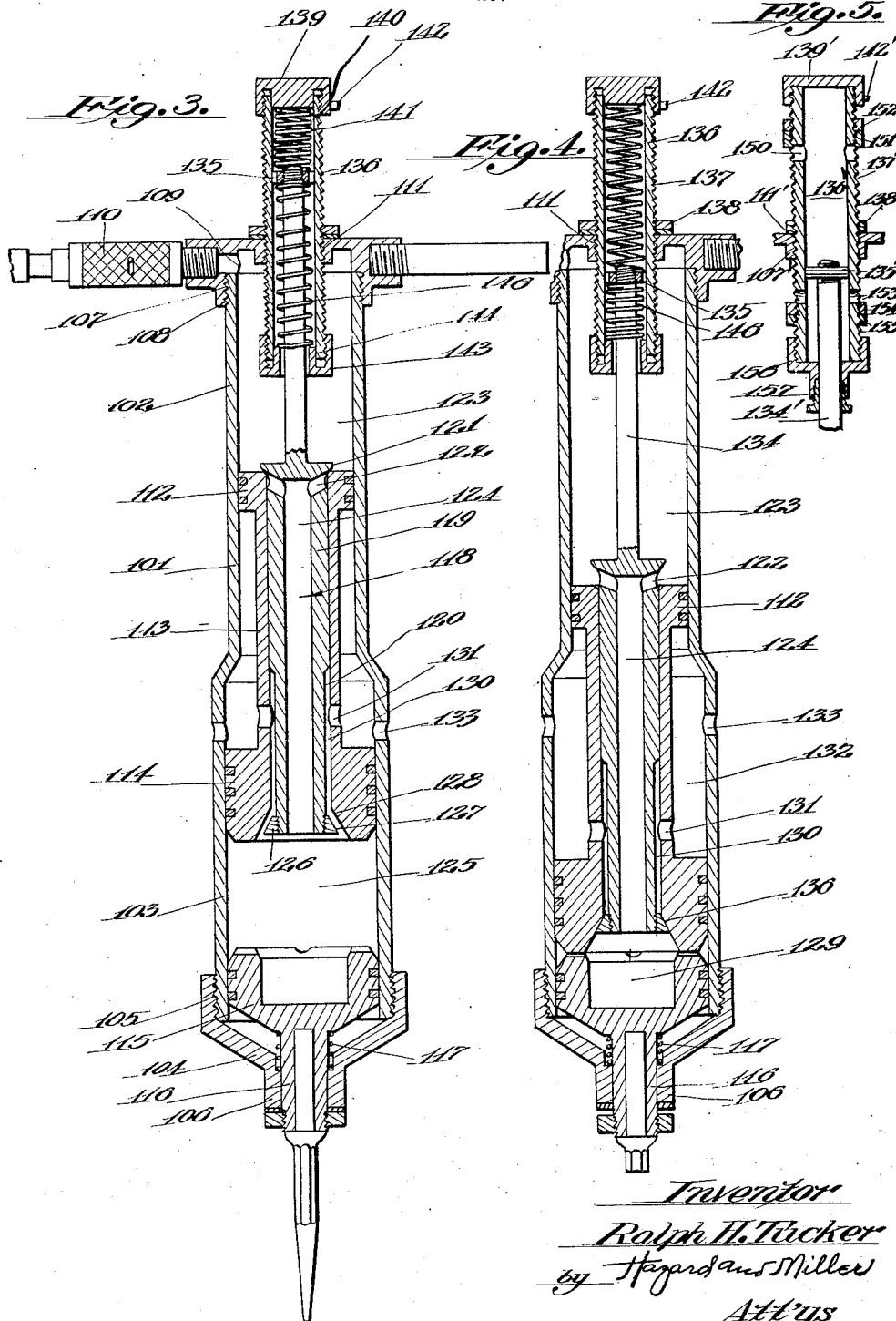
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UNITED STATES PATENT OFFICE.

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PNEUMATIC HAMMER.

Application filed October 29, 1924. Serial No. 746,555.

My invention is a pneumatic hammer having a positive return force to throw the piston on its return stroke.

This is done by the same air which drives the piston on its hammering stroke. I construct a piston with a valve sliding therein and resiliently connected to a fixed portion of the piston cylinder. By adjusting the tension of the resilient element I can cause the valve in the piston to open and pass the driving air through the piston to its front face, thereby forcing the piston back. In the specific construction I mount a sliding tube in the piston. The end of the tube has a rod attached thereto on which are mounted springs. These springs engage a fixed element in the piston cylinder and thereby draw the tube to open a valve allowing transmission of air from the cylinder to the front face of the piston. The air pressure thus returns the piston. On the return stroke of the piston an exhaust port is opened exhausting the air from the front of the piston.

My invention will be more clearly understood from the accompanying specification and drawings, in which

Figure 1 is a longitudinal section through my pneumatic hammer with the piston at the back part of the stroke.

Fig. 2 is a similar section with the piston at the forward end of the stroke and in contact with the anvil.

Fig. 3 is a sectional view of a modification with the hammer at the back part of the stroke showing the springs mounted in the handle head.

Fig. 4 is a sectional view of the hammer of Fig. 3 with the piston at the forward end of the stroke.

Fig. 5 is a modification of Figs. 3 and 4 in which compressed air is used instead of the springs.

As shown in the drawings, a piston cylinder 1 is formed with a compressed air section 2 and a piston section 3 with a sleeve connector 4 having screw threaded engagement 5 with the sections 2 and 6 with the section 3. At the end of the section 2 is the usual air and handle connection 7 which has a screw threaded engagement 8 thereon. A spider

9 is situated between the two sections of the piston cylinder and has a rim 10 engaging the end 11 of the section 2 and the end 12 of the section 3. It is formed with a central hub 13 with an aperture 14 for a purpose which will be hereinafter described.

A hammer cylinder 20 is connected to the piston cylinder preferably by a reducer coupling 21 having screw threaded engagement 22 with the section 3 and 23 with the cylinder 20. It is necessary to have the hammer cylinder of larger diameter than the piston cylinder for a purpose which will be hereinafter described. Therefore I use a reducer coupling adapted to connect tubes of different diameters. The hammer cylinder has a cap 24 screw threaded at 25 on the lower end thereof and preferably has a cushion 26 on the end of the neck 27 of the cap.

The piston 30 has attached thereto a long cylindrical sleeve 31 which is of a larger diameter at the lower portion 32. The piston head 33 carries the usual piston rings 34.

The hammer 35 has rings 36 to form an air tight bearing with the hammer cylinder 20. It is preferably connected to the lower portion 32 of the sleeve by a screw threaded connection 37.

The hammer valve 40 comprises a valve tube 41 having a valve head 42 at one end and of sufficient diameter to bear on the face of the piston head 33 as shown in Fig. 1. Apertures 43 extend from the outside to the inside of the tube 41 in a position immediately below the head 42. At the other end of the valve tube 41 is mounted a valve head 44 which is secured to the tube by a screw threaded engagement 45. The valve head preferably has a conical surface 46 to contact with the conical surface 47 of the hammer 35, as shown in Fig. 2. The valve tube 41 has a sliding fit with the sleeve 31 adjacent the piston head and at the hammer end there is an annular space 49 between the tube 41 and the lower end 32 of the sleeve. Ports 50 lead through the lower end 32 of the sleeve from the annular chamber 49 to an exhaust chamber 51 between the sleeve 31, the interior portion of the cylinder 20, and section 3 between the piston head and the hammer. Exhaust ports 52 in the wall of

the cylinder 20 are for a purpose hereinafter described.

The controlling mechanism of the valve 40 is as follows:

5 A stem 55 is secured to or formed integral with the hammer valve 40 and is preferably screw threaded at one end 56 on which a nut 57 is adjusted by means of the wrench head 58. A spring 59 encircles the stem 55 and
10 bears on the nut 57 and the spider 9. A second spring 60 is also mounted on the stem 55 and bears against the spider and the valve head 42.

The anvil 65 is constructed with a cylindrical interior chamber 66 and has the usual
15 face 67 to contact with the hammer face 68. The anvil has the usual stem 69 sliding in the neck 27 of the cap 24. The spring 70 bearing against the anvil and the neck is of the usual construction. A stop nut 71 is
20 shown secured by screw threads 72 to the lower end of the stem 69. A tool 72 is shown mounted in a socket 74 in the anvil stem.

25 The operation of my hammer is as follows:

Presuming the various moving elements are in the position shown in Fig. 1, compressed air will be introduced into the piston
30 cylinder 1 in the usual way. This air will press on the wrench head 58, and piston head 33, forcing them downward. The effective area of pressure is equal to the cross section of the piston cylinder 1. In
35 this movement the valve head 42 is maintained in contact with the piston head 33 and the ports 43 are closed as shown in Fig. 1. The pressure of the spring 60 performs part of this function of maintaining
40 the ports 43 closed as does also the pressure of the air on the wrench head 58.

By prearranged adjustment of the nut 57, the hammer valve 40 will be carried
45 down until the compression of the spring 59 is sufficient to retard its movement. As the piston is still traveling the ports 43 will be opened as shown in Fig. 2. This action allows the compressed air from the piston
50 cylinder 1 to flow through the interior of the tube 41 into the chamber 66 in the anvil. In the action above mentioned, the valve 44 is drawn upward until its conical surface 46 seats on the conical surface
55 47 of the hammer 35. The action above described of opening the hammer valve to allow compressed air from the piston cylinder 1 to the anvil chamber 66 preferably takes place immediately before the hammer
60 strikes the anvil. As the anvil is thrown downwardly by the impact of the hammer and the hammer retarded the compressed air fills the whole of the lower portion of the hammer cylinder 20. There is therefore a large area of the hammer against
65 which the compressed air acts. This forces

the hammer upward. The relative compressive force of the springs 59 and 60 is so adjusted that the lower spring 60 will force the valve head 42 into contact with the piston head 33 at the desired position in the
70 return stroke, thereby closing the ports 43. This movement of the hammer valve 40 downward in relation to the moving piston 31 and its connected hammer 35 opens the valve 44 and allows the compressed air
75 in the lower part of the hammer cylinder 20 to exhaust around the valve 44 through the annular space 49, through the ports 50 in the lower portion 32 of the sleeve, and through the exhaust ports 52 in the ham-
80 mer cylinder 20. These ports 52 and 50 are always open so that the air in the exhaust chamber 51 is normally at atmospheric pressure.

As above described, by adjustment of the
85 nut 57, which is readily actuated by means of the wrench head 58 after removing the handle connection 7, the compression of the spring 59 may be adjusted and thereby the moment of opening the valve 40 controlled.
90 The spring 60 may be readily changed by unscrewing the sections 2 and 3 and inserting a new spring.

The chief difference of the structure of Figs. 3 and 4 from that of Figs. 1 and 2
95 is in the manner of mounting the springs for tripping the valve.

In these figures, 101 is an integral casing in which the upper part 102 forms a piston cylinder or chamber and the lower
100 part 103 forms a hammer cylinder or chamber, formed with a larger diameter than the piston cylinder. A cap 104 is screw threaded on the lower end of the hammer cylinder as indicated at 105 and has a neck
105 106. At the upper end of the piston cylinder a handle head 107 is attached preferably by a screw threaded connection 108. This has an inlet port 109 controlled by the
110 usual throttle 110. Through the handle head 110 is a screw threaded aperture 111 for a purpose which will be hereinafter described. Sliding in the piston cylinder is a piston
112 with a sleeve 113 connected to an integral hammer 114. Both the piston and the
115 hammer have piston rings of the usual type on their peripheries. An anvil 115 is mounted in the lower end of the hammer cylinder and has a socket stem 116 sliding in the neck of the cap. A spring 117 re-
120 turns the anvil to its upper position after the hammer stroke in the usual manner.

Slidably mounted in the sleeve 113 is a valve 118 comprising an enlarged cylindrical section 119 at the upper end and a reduced preferably cylindrical section 120 at
125 the lower end. A valve head 121 formed integral with the section 119 engages the back face of the piston 112 as indicated in Fig. 3. Ports 122 open through the section 119
130

from the chamber 123 at the rear of the piston to a duct 124 through the center of the valve 118 which leads to the hammer chamber 125 at the front of the hammer as shown in Fig. 3. A conical valve head 126 is preferably screw threaded on the lower end of the reduced section 120 of the valve 118 and its beveled face 127 contacts with a similar beveled face 128 of the hammer 114 as shown in Fig. 3. The compressed air from the chamber 123 thus passes to the recess 129 in the anvil 115. An annular space forming an exhaust passage 130 is formed between the exterior of the reduced section 120 and the hammer 114 and sleeve 113. Ports 131 lead through the sleeve 113 to an exhaust chamber 132 between the sleeve 113 and the casing 101. From this chamber exhaust ports 133 lead to the atmosphere.

Formed preferably integral with the valve 118 is a stem 134 having at the upper end thereof a piston 135 preferably screw threaded on the upper end thereof which reciprocates with the piston in the spring cylinder 136. This cylinder is preferably screw threaded as indicated at 137 to allow threading through the screw threaded aperture 111 in the handle head 107. Lock nuts 138 are used to secure the cylinder in desired adjusted position. At the upper end of the cylinder is a closure cap 139 preferably screw threaded to the outside of the cylinder 136 and has an interior projection 140 forming a seat for the upper spring 141. The cap is preferably maintained from turning by a set screw 142 and is squared to form a wrench hold. At the lower end of the spring cylinder is a lower cap 143 preferably threaded on the outside of the cylinder 136 and has a collar 144 extending up in the cylinder. The stem 134 reciprocates through the collar 144. A lower spring 146 is mounted between the collar 144 and the piston 135.

The operation of the pneumatic hammer of Figs. 3 and 4 is as follows:

Presuming the parts are in the position of Fig. 3, compressed air is introduced in the usual manner to the piston chamber 123 and is of substantially constant pressure, being regulated by the usual throttle 110. The compressed air acts on the piston 112 and drives it downward into striking position with the anvil as shown in Fig. 4. The valve 118 altho lubricated has a certain sticking action in the sleeve 113 until the spring 146 is compressed sufficiently to snap the valve upward as shown in Fig. 4. This action preferably takes place by prearranged adjustment of the tension of the springs just before the hammer strikes the anvil. Compressed air from the chamber 123 passes through the ports 122 and the duct 124 to the recess 129 in the anvil. As the anvil is driven down the air fills the whole of the

chamber 125 and on account of the different effective area of the hammer face and piston face the hammer and anvil are driven upward by the differential compressed air pressure.

On the up stroke the ports 122 remain open until the upper spring 141 is compressed sufficiently to snap the valve 118 downward until the head 121 seats on the piston 112. This action lowers the valve 127 and allows a free exhaust passage from the chamber 125 past the conical surfaces 127 and 128, the annular passage 130, through the port 131 into the exhaust chamber 132. From here it exhausts into the atmosphere through the port 133. The cycle is now reversed and continued as above described.

The tension of each individual spring may be adjusted by screwing the cap 139 and collar 144 in and out of the cylinder 136. The length of stroke may be adjusted by screwing the whole cylinder 136 either down or up through the handle cap 107.

The construction of the device of Fig. 5 is as follows:

In this compressed air is substituted for the resilient springs of Figs. 3 and 4 to trip the valve 118. The stem attached to the valve is indicated by 134' and carries at its upper end a piston 135'. The handle head is indicated by 107' having a screw threaded aperture 111'. In this is mounted a screw threaded cylinder 136' having screw threads 137'. The lock nut 138' secures the cylinder in adjusted position. A cap 139' is screw threaded on the upper end of the cylinder and held in position by a set screw 142'.

Through the upper part of the cylinder are apertures 150 having a closure sleeve 151 and a lock nut 152 threaded on the outside of the cylinder so that the size of the apertures may be adjusted. Below the piston a second set of apertures 153 open into the cylinder and may be closed by the sleeve 154 and lock nut 155 screw threaded on the outside of the cylinder. A lower cap 156 is screw threaded on the lower end of the cylinder and has a stuffing box 157 through which the stem 134' reciprocates.

The operation of the device of Fig. 5 is as follows:

The stem 134' is reciprocated by the piston and hammer in the same manner as indicated in Figs. 3 and 4. As the piston 135' reciprocates in the cylinder 136' it forces the air in and out of the apertures 150 and 153, but beyond these apertures it compresses the air which functions in a manner similar to the springs of Figs. 3 and 4, that is, the compressed air in the lower part of the cylinder snaps the valve 118 upwardly and the compressed air in the upper part of the cylinder snaps it downwardly relative to the piston and hammer.

If the hammer is working under low pres-

sure of compressed air in the chamber 123, it may be desirable to close or nearly close the apertures 150 and 153 by the closure sleeves 151 and 154 respectively in order to increase the compression in the upper and lower part of the cylinder 136'. It may also be desirable to do this when working under high pressure if a particularly snappy action of the valve is desired.

It may be stated that the recess in the anvil has a decided function in the operation of the hammer. The hammer is to be utilized principally by air under pressure, in which a quick stroke is required on the working stroke and also a quick turn. The device in operation is radically different from steam operated pistons or the like in which a comparatively slow expansion of the steam on the working stroke is required and also a relatively slow forcing back of the piston by the steam on the large end of the differential.

In the first part of the working stroke which may be designated as the down stroke of applicant's combined piston and hammer, the air between the hammer and the anvil is exhausted. Immediately prior to the striking of the hammer and the anvil the sliding valve is drawn upwardly relative to the piston and permits the working air under high pressure to pass through the valve into the space between the hammer and the anvil. This air fills the recess in the anvil with air under pressure, this pressure being equivalent to that of the driving air and provides a relatively large quantity of air which may expand freely to force the piston and anvil into the initial position by acting on the hammer of large diameter. Were the anvil not recessed the device could not accommodate such a large quantity of air and there being a large body of air would force the hammer and piston upwardly, the valve quickly becoming closed on its upward movement and then allowing free exhaust of the air.

The recess in the anvil, by allowing a relatively large capacity of air between the hammer and the anvil also functions to maintain the anvil pressed closely to its work and thereby eliminates to a great extent incorrect strokes of the working tool by it becoming displaced from the work.

The applicant is aware of steam engine constructions or the like having differential pistons in which the steam under relatively high pressure has a working stroke against the small end of the piston and by means of a slide valve longitudinally through the piston gives a return stroke by action on the large end of the piston, however, it is readily manifest that applicant's construction of a pneumatic hammer is radically different from such types of mechanism.

Various changes may be made without de-

parting from the spirit of the invention as claimed.

I claim:

1. A pneumatic hammer comprising in combination a piston, a hammer connected thereto, a casing, a valve in the piston to admit compressed air from the back of the piston to the front of the hammer, a valve in the hammer to conduct air from the front of the hammer to the rear of the hammer, means connected to the casing to operate the valve, ports in the casing to exhaust air from the rear of the hammer, and an anvil having a recess in the casing positioned to be struck by the hammer, the recess forming an air space adjacent the face of the hammer when the blow is struck.

2. A pneumatic hammer comprising in combination a piston, a hammer connected thereto, a casing in which the piston and hammer operate, a reciprocating valve operating through the piston to the face of the hammer, means resiliently connected to the casing to reciprocate the valve and thereby admit compressed air from the back of the piston to the front of the hammer and to exhaust the air from in front of the hammer and an anvil positioned at the end of the casing to be struck by the hammer, the anvil having a recess opposite the end of the valve when the hammer strikes the anvil.

3. In a pneumatic hammer, a casing, a head on the casing, a piston with a hammer connected thereto reciprocating in said casing, a reciprocating valve operating through the piston and hammer, a stem on the valve, a cylinder having screw threaded engagement with the casing head, a piston on the stem, a resilient medium between the piston and the top and bottom of the cylinder to actuate the valve and an anvil in the casing positioned to be struck by the hammer.

4. A pneumatic hammer having a casing with a differential piston and hammer connected by a tubular sleeve, a tubular valve slidably mounted in the sleeve extending through the piston and hammer, having apertures adjacent the piston end and being open at the hammer end, means to flow a gas into the piston end of the casing, means to exhaust the gas from in front of the hammer to the back and outwardly through the casing, an anvil slidably mounted in the casing in front of the hammer, and means to slide the valve in the sleeve, the sleeve forming a closure for the said apertures.

5. A pneumatic hammer comprising in combination a casing having a piston and hammer of different diameters connected by a tubular sleeve, a tubular valve having lateral apertures adjacent the piston end, slidable in the sleeve and having an open end adjacent the hammer, there being an annular chamber between the sleeve and the valve at the hammer end, and exhaust ports through

the sleeve and through the casing in back of the hammer, a valve closure structure on the end of the tubular valve having engagement with the hammer and forming a closure for the annular chamber, means to reciprocate the valve in the sleeve on the reciprocating motion of the piston hammer and sleeve, the said reciprocating motion closing the apertures leading into the tubular valve and closing the passage to the annular chamber, and an anvil slidably mounted in the casing forward of the hammer. 10

In testimony whereof I have signed my name to this specification.

RALPH H. TUCKER.