Dec. 15, 1942. A. A. MATHESON 2,304,839

AIR CONTROL VALVE

Filed May 19, 1941 2 Sheets-Sheet 1

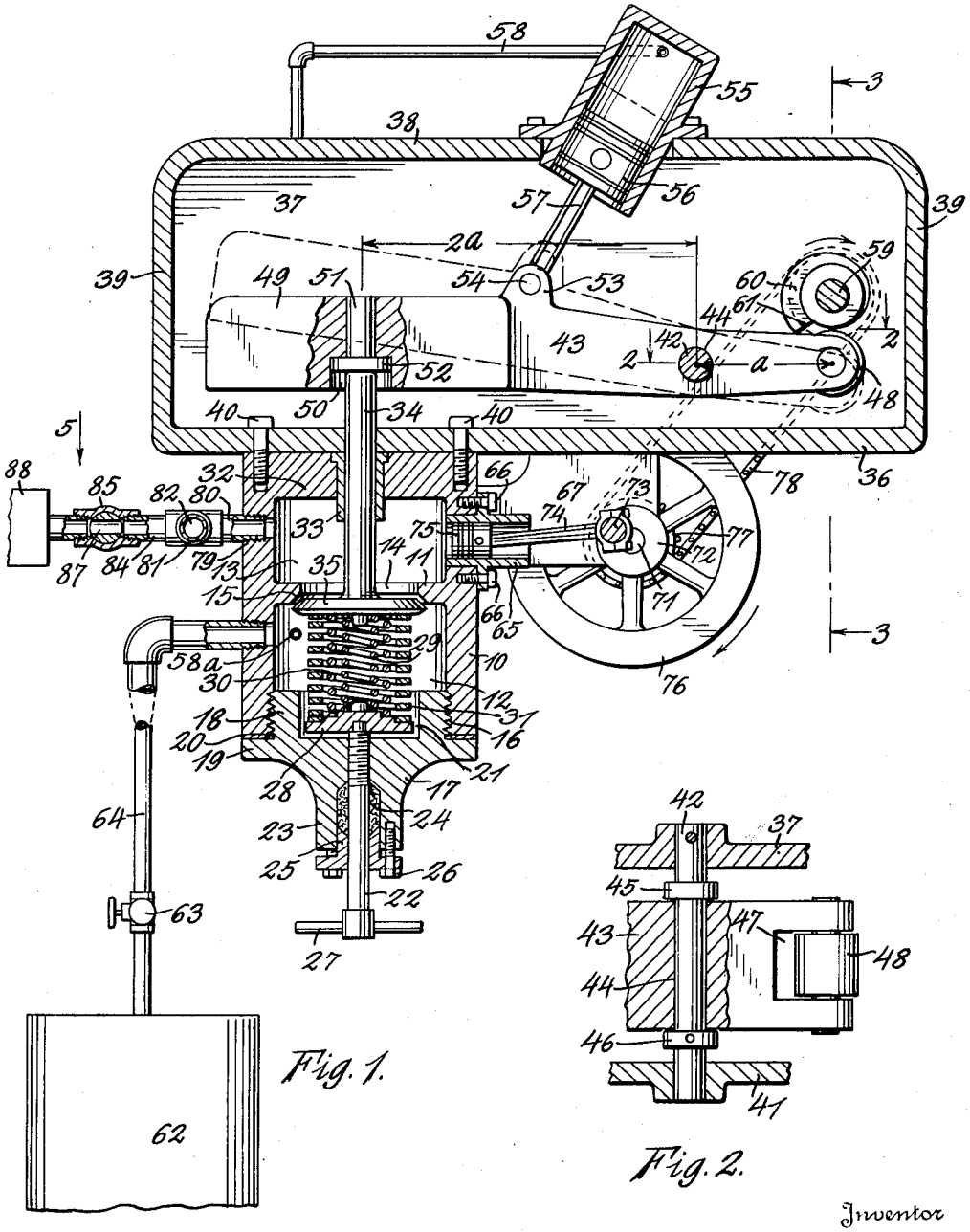


Fig. 1.

Fig. 2.

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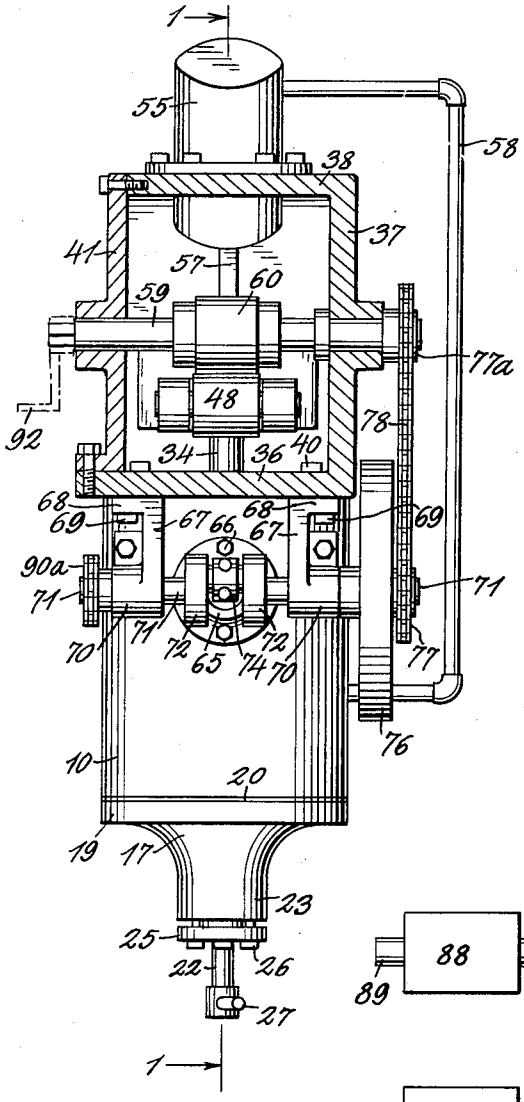


Fig. 3.

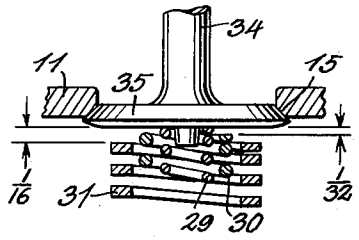


Fig. 4.

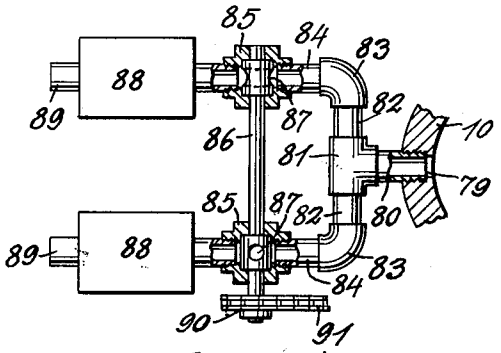


Fig. 5.

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UNITED STATES PATENT OFFICE

2,304,839

AIR CONTROL VALVE

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Application May 19, 1941, Serial No. 394,121

6 Claims. (Cl. 137—145)

This invention relates to improvements in valve mechanisms and has reference more particularly to an improved valve mechanism for releasing high pressure air or other gas in puffs, each containing a substantially equal quantity of air, in such a way that a series of blasts or puffs will result.

It has been found from extensive experiments that many useful and some unexpected results can be obtained from highly compressed air if it is released in a series of sharp puffs or blasts. In order to obtain the best results for a variety of purposes, it is necessary to employ a valve mechanism which will move to open position almost instantly and which will automatically close the instant after it has opened.

It has also been found that if the valve is so constructed that the air will be released in the form of an outwardly tapering cone, into a closed chamber, the sudden and violent agitation of the air effects a change that for want of better term will be referred to as ionization, as electrical energy seems to be generated and released.

It has been found that if a supply of air or other gas, is restrained by a valve of the poppet type that seats with the pressure so as to be urged into closed position thereby, that if the valve is moved to open position by a sudden blow, as of a hammer, it will open instantly in response to the impact and as suddenly close when the force of the blow is spent. The sudden opening and closing of the valve releases a quantity of air at a high velocity. When the air is discharged into an outlet chamber having a discharge opening of somewhat limited area, pressure will be built up in this chamber and since the poppet valve discharges the air in an outwardly tapering conical sheet, it will "crack" or ionize the air.

When the air from the outlet chamber is directed onto the skin, it exerts a massaging effect and increases the blood circulation whereby beneficial results are obtained in many ailments.

The air released in a series of puffs can also be utilized for many different mechanical operations, such as cleaning carpets and upholstered articles, the projection of projectiles, the transfer of concrete by a specially constructed gun designed for that purpose, for removing snow and for many other purposes.

It is the object of this invention to produce a valve mechanism by means of which highly compressed air, or other gas, can be safely and conveniently released in a series of puffs, each containing substantially the same quantity of air.

Having thus briefly described the invention and pointed out some of the objects thereof, the same will now be described in detail, and for this purpose reference will now be had to the accompanying drawings in which the invention has been illustrated, and in which:

Figure 1 is a vertical section through the valve mechanism, taken on line 1—1, Figure 3;

Figure 2 is a section taken on line 2—2, Figure 1;

Figure 3 is a view partly in elevation and partly in section, taken on line 3—3, Figure 1;

Figure 4 is a fragmentary section similar to that shown in Figure 1, showing the valve in closed position and showing also the relationship of the springs to the poppet valve; and

Figure 5 is a view, partly in elevation and partly in section, looking in the direction of arrow 5, in Figure 1.

In the drawings, reference numeral 10 designates a hollow body which is divided by a partition 11 into a pressure chamber 12 and an outlet chamber 13. The partition has an opening 14 and the wall of this opening is provided with a valve seat 15 positioned on the compression chamber side. The lower end of the body 10 is open and provided with a threaded section 16. A closure member 17 is provided with an upwardly extending threaded portion 18 that is screwed into the open end of the body and this closure member is also provided with a flange 19 which is separated from the end of the body 10 by means of a gasket 20. The upper end of the closure member has a depression 21 into which the upper end of the adjusting screw 22 projects. The downwardly extending portion 23 of member 17 has an enlarged opening 24 for the reception of packing material that is held in place by means of an adjustable gland member 25 that is held in place by a plurality of screws 26. Member 22 is provided at its lower end with a transverse bar 27 by means of which it can be rotated. Resting on the upper end of member 22 and positioned in the recess 21 is an abutment member 28 on which a plurality of springs rest. These springs have been designated by reference numerals 29, 30 and 31. Spring 29 is the smaller and weaker of the three springs shown. Spring 30 is somewhat stronger than spring 29 and spring 31 is much stronger than either of the others. The reason for this arrangement of springs will be explained hereinafter. The top of the outlet chamber 13 is closed by an integral

top 32 which has a central opening in which is located a bushing 33. The valve stem 34 that projects upwardly from the poppet valve 35 extends through the outlet chamber and through the bushing 33 in the manner shown quite clearly in Figure 1. Springs 29, 30 and 31 extend upwardly from the abutment 28 and spring 29 is always under compression engaging the abutment and the under surface of the poppet valve. Spring 29 is of sufficient strength to hold the poppet valve against the seat at all times except when it is acted upon by the forces provided for periodically opening the valve.

Referring now to Figure 4, it will be seen that the intermediate spring 30 is spaced approximately one-thirty-second of an inch from the lower surface of the poppet valve when the latter is seated and spring 31 is spaced approximately one-sixteenth of an inch from the valve. The object to be attained by the arrangement shown in Figure 4 is to exert sufficient force against the poppet valve to assure that it will move to closed position, in which position it will be held by the gas or air pressure in a manner which will hereinafter appear. When the valve is moved to open position, it is resisted only slightly by the action of spring 29, but when it engages spring 30, this resistance increases greatly and when it engages the powerful spring 31, the downward movement of the valve ceases almost immediately. The function, therefore of springs 30 and 31 is to provide a resilient stop for the valve.

Secured to the top of the hollow body 10 is a frame or housing having a bottom 36, a side wall 37, a top 38 and ends 39. This frame or housing is secured to the body 10 by means of tap screws 40. The open end of the housing is normally closed by a removable cover 41 that is shown in Figure 3. A pivot 42 has one end secured to the side 37 and the other end supported in an opening in the cover 41 in the manner shown in Figure 2. An impact member or hammer 43 is provided near one end with a bearing 44 for the reception of the pivot 42. Collars 45 and 46 serve to hold the hammer in a predetermined longitudinal position on the pivot. The lighter or smaller end of the hammer is provided with a notch 47 in which is rotatably supported a roller 48. The impact member or hammer extends to a point to the left of the valve stem 34 when viewed as in Figure 1 and terminates in a heavy end portion which has been designated by reference numeral 49. This portion is provided in its inner surface with a recess 50 which is positioned so as to be concentric with the valve stem 34 and positioned in this recess is a steel pin 51 having an enlarged head 52. The purpose of the steel pin and head is to resist destructive forces of the impact to which reference will hereinafter be made. If we consider the distance between the axis of the roller 48 and the center of the pivot 42 as *a* the distance between the center of the pivot and the center of the steel pin 51, will be 2*a*. At a point half way between the steel pin 51 and the pivot 42, the impact member is provided with spaced lugs 53 that are perforated for the reception of a pivot pin 54. Secured to the top 38 is a cylinder 55 and this is provided with a piston 56 that is connected with the pivot 54 by means of a connecting rod 57. A pipe 58 connects the interior of the cylinder with the interior of the compression chamber 12 the opening into the pipe 58 being indicated by 58*a*. It will thus be seen that any pressure prevailing in the pressure chamber 12 will be communicated to the cylinder 55 and to the piston 56, and this pressure will tend to move the piston with its attached impact member 43 downwardly. A shaft 59 is journaled in suitable bearings in side 37 and cover 41, as shown in Figure 3. Attached to the shaft 59 is a cam 60 which terminates abruptly along lines 61. This cam is designed to rotate in a clockwise direction when viewed as in Figure 1 and since it is positioned in line with the roller 48, it is evident that it will move the right hand end of the impact member downwardly once during each revolution. When the cam reaches the point where it no longer engages the roller, the latter is free to move upwardly under the action of gravity and the pressure prevailing in cylinder 55.

The cylindrical container designated by reference numeral 62 is presumed to contain air or other gas under very high pressure, the pressures some times reaching 1500 pounds or more per square inch, but most generally being somewhat lower than this or in the neighborhood of 1000 pounds per square inch. When the valve 63 is opened, the pressure prevailing in cylinders 62 will be communicated through the pipes 64 to the interior of the body member 10 and the pressure in chamber 12 will then become equal to that in the cylinder 62. The pressure prevailing in chamber 12 will also be communicated to the cylinder 55, through pipe 58. It is apparent that the pressure in chamber 12 will act upon the poppet valve in a manner to seat the same securely and therefore prevent gas from flowing into the outlet chamber 13. If the upper end of valve stem 34 is now given a sharp blow with a hammer or other impact device, valve 35 will be instantly unseated, thereby permitting some gas or air to escape from chamber 12. It is for the purpose of unseating the poppet valve that the impact member shown and above described has been provided.

In order to make the impact member function, shaft 59 must be rotated in a clockwise direction when viewed as in Figure 1 and this may be accomplished by means of an electric motor, by means of a hand crank or by the means shown in the drawings which will now be described.

A cylinder is secured in an opening in the wall of member 10 and has its inner end in communication with the outlet chamber 13. This cylinder is held in place by suitable cap screws 66. Cylinder 65 is part of a casting having side members 67 that are provided with flanges 68 through which securing bolts 69 extend and by means of which they are attached to the bottom 36. Mounted for rotation in bearings 70 in side member 67 is a crank shaft 71. This shaft is provided with spaced crank disks 72 connected by a crank pin 73. The connecting rod 74 has one end connected with the crank pin 73 and the other pivotally connected with piston 75. A heavy flywheel 76 is attached to one end of shaft 71 and outside of this there is a sprocket wheel 77 which is also attached to the shaft 71. Shaft 59 is provided with a sprocket wheel 77*a* which is identical in size with sprocket wheel 77 and these two sprocket wheels are connected by a sprocket chain 78. It is now evident that shafts 59 and 71 will rotate in the same direction and at the same speed. The outlet chamber 13 is provided with an opening 79 to which an outlet pipe 80 is threadedly connected. This outlet pipe may be connected directly with a hose or with another pipe terminating in a nozzle, but

in Figure 5, it has been shown as connected by means of a T 81 with connectors 82 that in turn are connected with elbows 83 from which connectors 84 extend. Secured to the ends of connectors 84 are rotary valves 85 that are interconnected by means of a shaft 86. These valves have openings 87 positioned at right angles to each other so that when the shaft is rotated, one or the other of these valves will be open. The discharged air or gas will then pass alternately into the outlet chambers 88. Pipes 89 are connected with chambers 88 and pipes or hose may be connected to pipes 89 for any desired purpose. The shaft 86 is provided with a sprocket wheel 90 and this is connected by means of a sprocket chain 91 with a similar sprocket wheel 90a secured to the crank shaft 71 as shown in Figures 3 and 5.

Let us now assume that the cylinder 62 contains air under pressure, for example, from 800 to 2000 pounds per square inch, and that valve 63 is open. Air will flow into the compression chamber 12 until the pressure therein is equal to that in cylinder 62 and this pressure will also be communicated through pipe 58 to the interior of cylinder 55. If shaft 59 is now rotated by means of a crank 92 or by any other suitable means through approximately 360 degrees, it will be observed that cam 60 will move the impact member from full line to dotted line position and piston 75 will return to approximately the position shown in Figure 1. If the shaft is now rotated until the cam releases the roller 48, the pressure in cylinder 55 will force the piston 56 downwardly, thereby moving the impact member downwardly at a high rate of speed until the head 52 of the steel pin engages the end of valve stem 34. This impact or hammer blow will unseat the poppet valve, thereby permitting air to escape into the outlet chamber 13. Due to the upwardly tapered walls of the valve seat and valve, the escaping air will form an upwardly tapered cone and since the streams converge towards the valve stem at an enormous velocity, the extreme agitation to which the air is subjected will cause ionization of the air particles. Immediately after the valve has been opened, it will be returned to closed position by the action of the air pressure in chamber 12, and the amount of air escaping will therefore be quite limited. When the valve opens the pressure in chamber 13 will immediately rise to a very high value and this pressure will act on the piston 75 causing the shaft 71 and flywheel 76 to turn in a clockwise direction. The flywheel is quite heavy and since the interior of outlet chamber 13 is connected with the atmosphere through the pipes and valves shown in Figure 5, the high pressure therein will soon be dissipated, thereby permitting the flywheel to return the piston 75 to the position shown in Figure 1 and just before this position is reached, the impact member will be released and permit another puff of air to enter the outlet chamber 13, whereupon the piston 75 will move towards the right and in this way the operation will continue indefinitely so long as air under sufficient pressure is supplied by cylinder 62.

The engine just described can be replaced by an electric motor, by a gasoline engine, or by any other suitable prime mover, but when the device is constructed in the manner shown and described, it will be self-contained and can be used where electricity is not available.

The parts are so adjusted that the forces acting on the under side of the poppet valve will be greater than the force acting on the upper end of the valve stem and therefore the valve will close as soon as the force of the impact has been dissipated.

By means of the adjusting screw 22, the tension of the springs can be adjusted so as to get the most desirable operation.

The air puffs produced by this machine can be employed for many purposes and it is not the intention to describe every use to which this machine may be put, but rather to limit the description to the construction of the mechanism employed.

Having described the invention, what is claimed as new is:

1. In a valve mechanism for use in effecting periodic release of quantities of gas under pressure, having a valve body provided with a pressure chamber and an outlet chamber separated by a partition having an opening, a valve seat on the pressure chamber side of the partition, and a poppet valve in operative engagement with the valve seat, the pressure of the air tending to hold the valve seated; means for periodically opening the valve comprising a pivoted impact member having a greater mass on one side of the pivot than on the other, the heavier end being positioned to engage the valve to move it to open position against the action of the force tending to seat it, biasing means comprising, a gas pressure responsive device, for urging the impact member into engagement with the valve, means comprising a rotatable cam in operative engagement with the lighter end of the impact member to periodically move it away from the valve in opposition to the biasing means and to suddenly release it whereby it will move, in response to the biasing means, into engagement with the valve, the static forces exerted on the valve by the impact member tending to open the valve, being less than the forces tending to close it whereby the valve will begin to close immediately after the impact member has come to a stop.

2. In a valve mechanism for use in effecting periodic release of quantities of a gas under pressure, having a valve body provided with a pressure chamber separated by a partition having an opening, a valve seat on the pressure chamber side of the partition, and a valve of the poppet type in operative engagement with the valve seat, the pressure of the gas tending to hold the valve seated; means comprising an impact member for delivering a hammer blow to the valve for moving it to open position, biasing means comprising, a gas pressure responsive device, for urging the impact member towards the valve, the combined forces due to the weight of the impact member and the action of the biasing means being less than the force tending to seat the valve, whereby it will seat immediately after it has been opened by the impact, and means comprising a rotatable cam for moving the impact member away from the valve against the action of the biasing means and for quickly releasing it to subject the valve to a hammer blow which moves it to open position.

3. An impact device for suddenly opening a poppet valve that closes with the pressure, comprising in combination, a frame provided adjacent one end with a bearing whose axis is substantially horizontal, a pivot pin projecting from the frame in spaced parallel relation to the axis of the bearing, a shaft mounted for rotation in the bearing, a cam secured to the shaft, an im-

pact member mounted for oscillation on the pivot, one end of the impact member being lighter than the other and positioned in the path of the cam, whereby when the cam is rotated the impact member will be rocked on its pivot, and biasing means comprising a gas pressure responsive device for urging the lighter end of the impact member against the cam, the heavier end of the impact member being positioned to engage the end of the poppet valve stem, whereby when the impact member is released by the cam it will strike the stem a hammer blow of sufficient intensity to open the valve, the weight of the impact member plus the force exerted due to the biasing means, being less than the force tending to seat the valve after it has been moved to open position by the hammer blow exerted thereon by the impact member.

4. A device in accordance with claim 3 in which the hammer end of the impact member is provided with a removable rivet-like impact member of hardened steel.

5. A device in accordance with claim 3 in which the biasing means that cooperates with the impact member comprises, a cylinder and a piston one of which is attached to the impact member and the other to the frame.

6. A device for controlling the flow of a compressed gas comprising a body having a chamber in which gas is present under pressure, one wall of said chamber having an opening surrounded by a valve seat facing the interior of the chamber, a poppet valve positioned to engage the seat when in closed position, means for urging the valve towards the seat comprising at least two compression springs of unequal strength, the weaker of which is constantly under compression and has one end in engagement with the valve, the stronger spring being spaced a short distance from the valve when the latter is closed, and means comprising an impact member for moving the valve to open position against the action of the forces tending to hold it in closed position, the stronger spring serving as a resilient abutment for limiting the opening movement of the valve in response to the hammer blow of the impact member, the combined valve closing force due to the action of the weaker spring and the pressure of the gas being sufficient to close the valve in opposition to the static force exerted thereon by the impact member but insufficient to resist the force due to the momentum of the impact member.

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