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VALVE CONTROL MECHANISM FOR AIR GUNS

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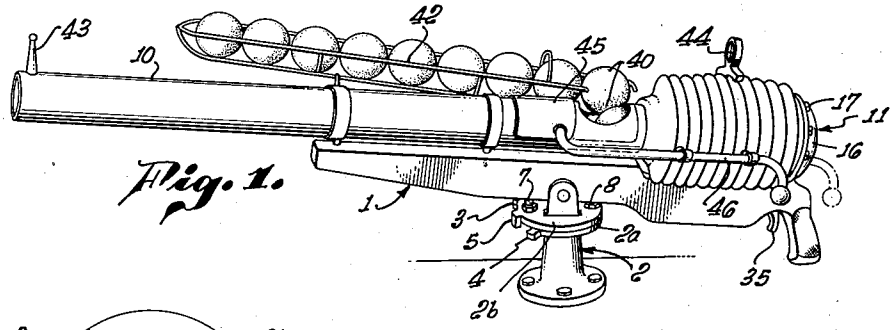

Fig. 1.

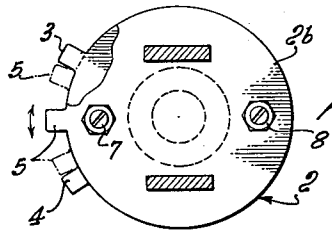

Fig. 3.

Fig. 2.

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VALVE CONTROL MECHANISM FOR AIR GUNS

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9 Claims. (Cl. 124—11)

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The present invention relates to pneumatic guns and has for its object to provide a quick firing gun capable of projecting ammunition at high speed. A further object is to provide a gun within which air is continuously maintained under sufficient pressure uninterruptedly to attain such projection velocity. Still another object is to provide a valve control mechanism designed to permit of very rapid firing of the gun.

These and other objects of the invention together with the many advantageous features thereof will be better understood from the following detailed description and by referring to the accompanying drawing in which a preferred form of the invention is illustrated.

In the drawing:

Fig. 1 is a side elevational view of an air gun embodying the invention;

Fig. 2 is a view, on a larger scale, of the rear end of the gun and taken substantially through the vertical center thereof, and

Fig. 3 shows a detail of construction taken substantially on line 3—3 of Fig. 2 in the direction of the arrows.

In the form illustrated in the drawings, the device of the invention includes a support bracket, or cradle 1 which is intermediate its ends mounted for oscillating and rotative movement on a pedestal 2 to enable the person operating the gun to aim the gun in any desired direction. However, since it is the intent and purpose of the invention to confine the use thereof to target shooting, the range of movement of the gun is limited by placing adjustable stops 3, 4 on the lower, stationary portion 2^a of the pedestal for engagement by a projection 5 of the upper portion 2^b which is seated for rotation on the pedestal 2^a. Oscillation in a vertical plane is similarly limited by means of suitable adjustable stops 7, 8 of the cradle. In such manner, it is seen that the range of the gun may be adjusted to suit conditions and to comply with rules governing the use of such devices.

A gun barrel 10 is rigidly secured to the cradle and an enlarged cylindrical housing 11 extends from the rear end of this barrel in axial alinement therewith. This housing is also rigidly secured in position on the cradle to support therein the pressure control mechanism of the gun, as best shown in Fig. 2. The inner end of the passage 11^a, within which the barrel is anchored, is shown recessed to form a seat 11^b for the master valve 13 of the gun and this valve is part of a piston 14. This valve is in order to provide a tight fit shown fitted with an O-ring 12 and the seat 11^b is set at an angle of about 60°

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relative to the axis of the gun barrel and valve axis, further to insure such leak-proof joint and also better to align the valve with its seat. The farmer is seated for limited sliding movement within a cylinder 15 in the manner and for the purpose which will now be described.

The cylinder 15 is rigidly secured to a cap 16, which closes the rear end of the housing and is clamped in position thereon in any suitable manner, as by bolts 17. It is important to note that the cylinder is much smaller in diameter than the space within the housing and that, in this manner, an annular chamber 18 is formed about the cylinder. Below the housing, within a recess 1^a sunk into the cradle of the gun, is placed a trigger support 20, through which a passage 21 carries air under pressure from a supply hose 22. The latter is in any conventional manner connected continuously and uninterruptedly to carry pressure fluid to the chamber 18, while the gun is in use.

A threaded rod 25 is seated in the piston 14 and rigidly clamped in position therein by a nut 26. This rod extends axially through the cap 16 into a recess 23 sunk into the rear end thereof of a diameter to receive therein a piston 27. The purpose of this piston is to control the operation of the master valve 13. A plate 24 tightly closes the entrance to this recess. It is important to note that the rod 25 extends freely into the piston 27 and that a threaded nut 28 at the end of the rod engages a shoulder 27^a within the piston. A stop collar 30 is placed within a groove in the inner wall of the recess 23 and it is particularly to be noted that the parts are so arranged and proportioned that the piston is afforded very limited axial movement within the recess between this collar and the shoulder 23^a.

As above stated, pressure fluid is free to flow into the annular chamber 18 to maintain the master valve 13 normally on its seat 12. A trigger 35 is pivotally secured to the rear end of the support 20 in position to push a valve 36 away from its seat and so to open a passage for the pressure fluid through passages 37, 38 to the bottom of the recess 23. The fluid now entering this recess exerts sufficient pressure against the piston 27 to move the latter rearwardly against the stop collar 30 and, in moving, to push the nut 28 rearwardly, thereby slightly to withdraw the master valve from its seat, against the tension of a spring 39. The latter is merely powerful enough normally to maintain the master valve seated.

The air from the pressure chamber 18 now

rushes through the narrow valve opening to encounter the resistance of the atmospheric pressure within the gun barrel; a resistance which is sufficient further to move the valve 13 away from its seat and so fully to open the valve for the free flow of the pressure fluid into the barrel. The effect of this arrangement is momentarily to check the flow of the pressure fluid and then to release the fluid so suddenly that the instantaneous pressure fluid expansion and rush through the barrel is accompanied by a very loud report, not unlike the report of a gun powder exploded gun. It is important to note that the rod 25 and nut 28 are free to move within the piston 27 during this valve opening movement.

In the upper surface of the gun barrel is cut an opening 10a of a size to admit therethrough a ball 40 which, by the explosive expansion and flow of the pressure fluid is projected through the barrel at an enormous rate of speed to land on the target several rods away from the gun. A ball receptacle or magazine 42 is mounted on the gun barrel, slightly to one side thereof so as to clear the gun sights 43, 44, and means should be provided for admitting the balls one by one from this magazine to the barrel. For the sake of simplicity and clearness, this means is in the drawings shown to consist of a cap 45 of a size normally to close the opening 10a, and a rod 46 extends from this cap to the rear end of the housing 11 for convenient manual operation to load the gun before the trigger is pulled to discharge the ammunition. But, of course, where such cap is used, means must be added to maintain the cap seated on the barrel.

The proportions of the various parts and of the areas and volumes of the spaces within the gun are of great importance and must be held very close limits. It is, for instance, absolutely essential that the diameter of the passage through the gun barrel is a little less than the inner diameter of the cylinder 15 and the piston 14 seated therein. Also that the diameter of the valve 13, at the point where the O-ring 12 contacts the valve seat 11b is greater than the inner diameter of the barrel. Had the opposite relations existed, the result would have been to cut down the air resistance within the barrel and to increase the pressure resistance behind the piston sufficiently to ease the flow of pressure fluid into the barrel and so to soften the impact of the gun firing. The tension of the springs 29, 39 is also important and should be merely sufficient to overbalance the friction of the pistons 14 and 27 within their bearings.

Since, as above explained, the master valve is suddenly projected into fully open position, it is advisable to provide means for arresting this opening movement and this may be done by placing an annular stop member 50 within the cylinder 15 and to mount a resilient bumper 51 against this member for contact by the piston 14 when the valve reaches fully open position. The opening through this bumper stop should be larger than the nut 26 of the valve rod 25 to permit escape of fluid into the inner space 52 during the opening movement of the valve. It is also to be noted that a passage 53 leads from this space to the recess 23 directly behind the stop collar 30 to relieve the pressure behind the piston 27 while the latter moves to initiate the valve opening movement. A relatively very fine passage 55 leads from the inner chamber 52 through the cap 16 to the atmosphere to assist in equalizing the pressure within this chamber and the recess 23 each time the gun has been fired.

It should be clear from the foregoing description that I have produced a pneumatic gun within which air may continuously be maintained under sufficient pressure to expel projections at high speed and wherein the valves and valve controlled passages are so proportioned that the area within these passages is greater than the inner area of the gun barrel. But while the device described and illustrated is capable of producing these results, it is not intended thereby to limit the device to the exact arrangements and proportions shown, and modifications thereof may be embodied within the scope of the claims hereto appended.

I claim:

1. In a pneumatic gun having a barrel and an enlarged cylindrical pressure chamber in axial alinement with said barrel, the wall of the chamber being recessed to form a co-axial valve seat at the entrance to the barrel, a conduit for continuously admitting pressure fluid to said chamber, a cylinder co-axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and master valve, a piston slidable within said recess, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod contacting the rear surface of the piston, there being a passage from said conduit to the space in front of said piston, a control valve normally closing said passage, and a trigger for unseating said control valve to admit pressure fluid to the space in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly to open the master valve.

2. In a pneumatic gun having a barrel and an enlarged cylindrical pressure chamber in axial alinement with said barrel, the wall of the chamber being recessed to form a co-axial valve seat at the entrance to the barrel, a conduit for continuously admitting pressure fluid to said chamber, a cylinder co-axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and master valve, a piston slidable within said recess, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod contacting the rear surface of the piston, there being a passage from said conduit to the space in front of said piston, a control valve normally closing said passage, and a trigger for unseating said control valve to admit pressure fluid to the space in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly slightly to open the master valve, the pressure within the chamber completing the opening movement of the master valve, the rod of the latter being free to move rearwardly through the control cylinder piston.

3. In a pneumatic gun having a barrel and an enlarged cylindrical pressure chamber in axial alinement with said barrel, the wall of the chamber being recessed to form a co-axial valve seat at the entrance to the barrel, a conduit for continuously admitting pressure fluid to said cham-

ber, a cylinder co-axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and valve, a piston slidable within said recess, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head adjustably fixed on the end of said rod and contacting the rear surface of the piston, there being a passage from said conduit to the space in front of said piston, a control valve normally closing said passage, a trigger for unseating said control valve to admit pressure fluid to the space in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly to open the master valve, and a buffer within the master valve cylinder limiting opening movement of the master valve.

4. In a pneumatic gun having a barrel and an enlarged cylindrical pressure chamber in axial alinement with said barrel, the wall of the chamber being recessed to form an inclined co-axial valve seat at the entrance to the barrel, a conduit for continuously admitting pressure fluid to said chamber, a cylinder co-axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and valve, a piston slidable within said recess, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod contacting the rear surface of the piston, means urging the piston against the head of the rod, there being a passage from said conduit to the space in front of said piston, a control valve normally closing said passage, and a trigger for unseating said control valve to admit pressure fluid from said conduit to the space in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly to open the master valve.

5. In a pneumatic gun having a barrel and an enlarged cylindrical pressure chamber in axial alinement with said barrel, the wall of the chamber being recessed to form a co-axial valve seat at the entrance to the barrel, a conduit for continuously admitting pressure fluid to said chamber, a cylinder co-axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against said valve seat, the diameter of the valve at the point of contact with its seat being greater than the inner diameter of the barrel, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and valve, a piston slidable within said recess, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod contacting the rear surface of the piston, there being a passage from said conduit to the space in front of said piston, a control valve normally closing said passage, and a trigger for unseating said control valve to admit pressure fluid to the space in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly to open the master valve.

6. In a pneumatic gun having a barrel and an enlarged cylindrical pressure chamber in axial alinement with said barrel, the wall of the chamber being recessed to form an inclined co-axial valve seat at the entrance to the barrel, a conduit for continuously admitting pressure fluid to said chamber, a cylinder co-axially mounted within the chamber, a master valve slidable within said cylinder, said valve having a gasket for contact with said seat, means urging the valve gasket against the said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and valve, a piston slidable within said recess, the space behind the piston communicating with the space within the master valve cylinder, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod contacting the rear surface of the piston, there being a passage from said conduit to the space in front of said piston, a control valve normally closing said passage, and a trigger for unseating said control valve to admit pressure fluid to the space within the cylinder in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly to open the master valve.

7. In a pneumatic gun having a barrel and an enlarged cylindrical pressure chamber in axial alinement with said barrel, the wall of the chamber being recessed to form a co-axial valve seat at the entrance to the barrel, a conduit for continuously admitting pressure fluid to said chamber, a cylinder axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against the said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and valve, a piston slidable within said recess, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod contacting the rear surface of the piston, there being a passage from said conduit to the space within the cylinder in front of said piston, a control valve normally closing said passage, a trigger for unseating said control valve to admit pressure fluid to the space in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly to open the master valve, and means limiting rearward movement of the piston.

8. In a pneumatic gun including a cradle, a housing rigidly mounted on said cradle and having an enlarged cylindrical pressure chamber therein, a barrel seated in said housing in axial alinement with said chamber, the wall of the chamber being recessed to form a co-axial valve seat at the entrance to the barrel, a conduit within the cradle for continuously admitting pressure fluid to said chamber, a cylinder axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and valve, a piston slidable within said recess, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod normally contacting the rear surface piston, there being a passage from said conduit to the space in front of said piston, a control valve within the cradle normally closing said passage, and a trigger at the rear end of the cradle operable to unseat said control valve to admit pressure fluid to the space in front of the piston thereby to move the piston rearwardly and

in moving to force the head of the master valve rod rearwardly to open the master valve.

9. In a pneumatic gun including a cradle, a housing rigidly mounted on said cradle, said housing having an enlarged cylindrical pressure chamber therein, a barrel seated in said housing in axial alinement with said chamber, the wall of the chamber being recessed to form a co-axial valve seat at the entrance to the barrel, a conduit within the cradle for continuously admitting pressure fluid to said chamber, a cylinder co-axially mounted within the chamber, a master valve slidable within said cylinder, means urging the valve against said valve seat, there being a cylindrical recess at the rear end of the gun in axial alinement with the cylinder and valve, a piston slidable within said recess, there being a space within the recess in front of and behind the piston, a co-axial rod rearwardly projecting from said master valve and freely extending through said piston, a head on the end of said rod normally contacting the rear surface of the

piston, there being a passage from said conduit to the space in front of the piston and a passage from the space behind the piston to the space behind the master valve, a control valve within the cradle normally closing said passage, and a trigger at the rear end of the cradle operable to unseat said control valve to admit pressure fluid to the space in front of the piston thereby to move the piston rearwardly and in moving to force the head of the master valve rod rearwardly to open the master valve.

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