(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 440 428 A2**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: **91300683.9**

(51) Int. Cl.5: **F41B 11/32**

(22) Date of filing: **30.01.91**

The title of the invention has been amended (Guidelines for Examination in the EPO, A-III, 7.3).

(30) Priority: **31.01.90 GB 9002202**

(43) Date of publication of application:
**07.08.91 Bulletin 91/32**

(84) Designated Contracting States:
**DE ES FR GB**

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## (54) Valve assembly for air guns.

(57) A valve assembly for supplying air under pressure to the firing chamber of an air gun includes a hollow cylindrical chamber which houses a slidable piston whose external diameter is slightly less than the internal diameter of the cylindrical chamber to define an airflow passage therebetween. Air under pressure is admitted to that portion of the chamber interior which lies to one side of the piston and the piston is moved along the chamber immediately before release of the air from the chamber in a sense further to compress the air present therein. The re-compressed air can then be selectively released from the cylindrical chamber to the firing chamber of the air gun.

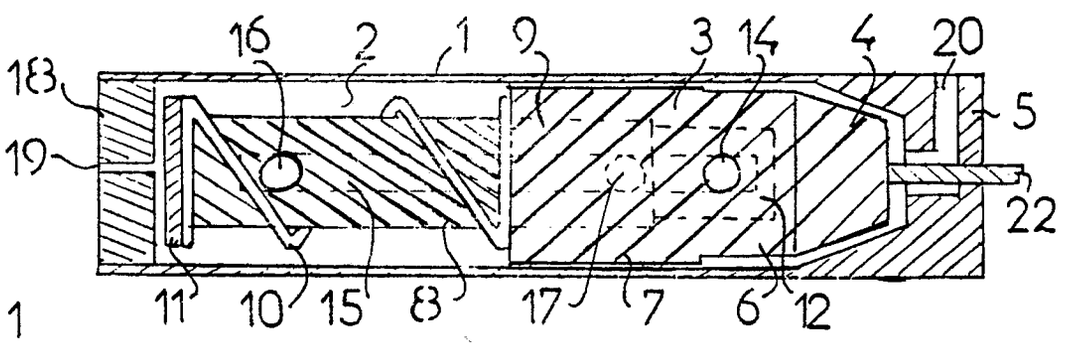


FIG.1

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# IMPROVEMENTS IN AND RELATING TO APPARATUS FOR USE WITH AIR GUNS

This invention relates to apparatus for use with air guns and more especially, but not exclusively, to a valve assembly for supplying air under pressure to the firing chamber of an air gun.

According to the present invention in one aspect, there is provided a valve assembly for supplying air under pressure to the firing chamber of an air gun, the assembly including a hollow cylindrical chamber which houses a slidable piston whose external diameter is slightly less than the internal diameter of the cylindrical chamber to define an airflow passage therebetween, means for admitting air under pressure to that portion of the chamber interior which lies to one side of the piston, means for causing the piston to move along the chamber immediately before release of the air from the chamber in a sense further to compress the air present therein, and means by which the recompressed air can be selectively released from the cylindrical chamber to the firing chamber of the air gun.

In one arrangement, the piston is biased towards one end wall of the chamber by a spring, movement of the piston caused by the firing mechanism automatically effecting further compression of the air present in the chamber.

The invention will now be described by way of example only with reference to the accompanying diagrammatic drawing in which:-

Figure 1 is a side elevational view in section of a valve assembly in accordance with the invention;

Figure 2 is a side elevational view in section of an alternative valve assembly in accordance with the invention;

Figure 3 is a plan view in section of a feature of the assembly illustrated in Figure 2;

Figures 4 and 5 are side elevational views in section of further valve assemblies in accordance with the invention; and

Figure 6 is a section taken along line VI-VI of Figure 5.

In the embodiment illustrated in Figure 1, the valve assembly comprises a casing 1 enclosing a hollow cylindrical compression chamber 2 which houses a piston 3 mounted for sliding movement within the interior of the chamber 2. One end of the piston 3 is shaped to define a sealing surface with a complementary surface of the adjacent end wall 5 of the casing when the piston 3 is moved to the right as shown. The piston 3 is stepped along its length such that one end 6 is of a diameter less than that of its other end 7. The diameter of the piston end 7 closely approaches the internal diameter of the chamber 1 to define an annular restricted flow passageway therebetween. The piston 3 co-operates with a second piston 8 whose leading end protrudes into a bore 9 formed in the piston 3. A spring 10 is mounted about the circumference of the second piston 8 and bears at one end against the trailing end of the stepped piston 3 and, at its other end, against a seal 11 mounted on the end of the piston 8 remote from the piston 3. The leading end of the piston 8 is spaced from the end face of the bore 9 to define a reservoir 12 which communicates with that portion of the chamber 2 to the right hand side of the piston 3 as shown in Figure 1 by means of a passageway 14.

The piston 8 is formed with a central bore 15 which communicates with the left hand side (as shown in Figure 1) of the chamber 2 via a passageway 16 and with the right hand side (as shown in Figure 1) of the chamber 2 through the restricted passageway defined between the periphery of the piston 8 and the internal surface of the chamber 2. Further communication between the left and right hand sides of the chamber is effected when a passageway 17 formed in the piston 8 aligns with the passageway 14. A pin may be provided to inhibit rotational movement of the piston 8 relative to piston 3 to ensure that the passageways 14,17 can properly be aligned.

The ends of the chamber 2 are closed by the end wall 5 and an end wall 18 which includes a passageway 19 for placing the left-hand side of the chamber 2 in communication with a conventional air pump. The end wall 5 includes a passageway 20 for placing the right-hand side of the chamber 2 in communication with an air release chamber of the air gun on which the valve is mounted. The passageway 20 is normally closed by the inclined end face 4 of the piston 3 making sealing contact with the complementary surface of the end wall 5. The piston is moved to the position shown in Figure 1, to open the passageway 20 when a piston stem 22 is propelled to the left as shown in the drawing by a firing mechanism of the gun.

In operation, air from a conventional air pump is admitted to the passageway 19 to move the seal 11 and the piston 8 against the action of the spring 10 to the right as shown to enable pressurised air to enter the chamber 2. The pressurised air passes along the annular space defined between the periphery of the piston 3 completely to fill the left and right hand sides of the chamber 2 and the bore 15 with air to the required pressure. When this has been achieved, the seal moves to the left to seal off the passageway 19. Thus, the interior of the chamber is charged to the pressure of air admitted to the chamber by the pump. On firing the air gun,

the firing mechanism comes into contact with the stem 22, so moving the piston 3 against the action of the spring 10 further to compress the air present in the left-hand side of the chamber 2 and to place the passageways 17,14 in communication one with the other to cause air under increased pressure to flow from the left to the right hand side of the chamber. In addition, movement of the piston opens the passageway 20 so enabling the re-compressed air present in the right hand side of the chamber to pass to the firing chamber of the air gun. The back-pressure created within the passageway 20 due to the pressure of a projectile within the barrel of the gun ensures that the valve remains open for the requisite time period.

Thus, the compressed air entering the compression chamber 2 is subjected to a further and significant compression stage before the re-compressed air is released to the firing chamber of the air gun.

The air valve assembly illustrated in Figures 2 and 3 comprises a lower chamber 24 which houses a chargeable air bottle 25. On opening a valve 28, compressed air from the bottle 25 enters the chamber 26 in front of the piston 27 and also passes via a passageway 29 to a re-compression chamber 30. The piston 27 is then advanced to the left further to compress the compressed air already present in the pump chamber 26 and the re-compression chamber 30. A knock-open valve 31 including a piston 32 is located within the chamber 30, one end of the piston being shaped to define a seal with a complementary shaped surface 33 of the chamber. On discharging the air gun, its firing mechanism is moved into contact with a spring-biased stem 31 which operates to move the piston 32 away from its seating with the surface 33 further to compress the re-compressed air present in the chamber and to cause the re-compressed air to pass via passageway 34 to the firing chamber 35 of the gun. The barrel of the gun is identified by reference numeral 36.

Thus, the compressed air initially supplied by means of the bottle 25 is subjected to two further compression stages before it enters the firing chamber of the air gun.

The air valve assembly illustrated in Figure 4 includes a piston 40 moveable by a manually operated piston rod 41 through a compression chamber 42. An 'O' ring seal 43 is carried by the piston 40 to provide a seal between the outer periphery of the piston and the inner periphery of the casing 44 of the chamber 42. The piston 40 includes a leading section 45 of reduced diameter. Also positioned in the air chamber is an end wall structure 46 formed with a channelled section 47 of internal diameter slightly greater than the diameter of the piston leading section 45. The channel led section 47 carries an 'O' ring seal 48 to provide a seal between the outer periphery of the channel led section 47 and the adjoining internal wall of the chamber casing 44.

The structure 46 is formed with an outlet passageway 49 for conveying air under pressure to the firing chamber of the gun on which the valve is mounted. The passageway 49 is normally closed by a knock-open valve 50 including a piston 51 having a shaped end 52 which seats against a complementary shaped surface of the structure 46.

As the piston 40 is initially propelled through the chamber 42 by means of the piston rod 41, air is gradually compressed and flows into the interior of the channelled section 47. Once the leading section 45 of the piston 40 enters the channelled section 47, however, air is returned under pressure to the chamber area 42 about the piston section 45. On continued movement of the piston, the compressed air is once more returned to the channelled section 47 until re-pressurisation is effected. Once the chamber is charged with air at the required pressure, so the spring biased knock-open valve 50 is operated by the stem to move the piston 51 to the right further to compress the re-pressurised air in the compression chamber. This compressed re-pressurised air flows around the piston 51 and through the passageway 49 to the firing chamber of the air gun. Back-pressure generated in the passageway 49 by the presence of a projectile in the gun barrel holds the valve open against the action of the spring for the requisite time to complete the firing action. The timing of valve opening can be controlled by suitable variation of the tension of the biassing spring.

Thus, the compressed air initially supplied to the chamber 42 is subjected to three further compression stages before it enters the firing chamber of the air gun.

Turning now to the embodiment illustrated in Figures 5 and 6, the air valve comprises a piston 55 moveable through a compression chamber 57 and a manually operated piston 56 moveable through a second compression chamber 54. An "O" ring seal 58 is carried by the piston 55 to provide a seal between the outer periphery of the piston 55 and the inner wall of the valve casing 71. An "O" ring seal 61 is also carried by the piston 56 to provide a seal between the outer periphery of the piston 56 and the inner wall of the casing 71. The piston 56 further includes a spring loaded valve 62 vented to atmosphere via a passageway 63. The spring loading is such that the valve 62 places the space between the pistons 55,56 into communication with the atmosphere when the pressure extant in the space is equal to or less than atmospheric pressure.

The piston 55 includes a section 64 of reduced

diameter similar to piston section 45 of Figure 4. In this embodiment, however, the piston 55 is formed with an internal bore 65 within which is housed a spring loaded member 66. The right hand end of the member 64 (as shown in Figure 5) is shaped to define a sealing surface 67 with a complementary shaped seating of the member 66 when the member 66 is urged to the right by the spring 68. An apertured plate 69 (see Figure 6) is positioned over the left hand end of the bore 65.

The end of the piston 55 remote from the piston 56 protrudes into a channelled structure 59 similar to the channelled structure 47 of Figure 4. An "O" ring seal is carried by the piston 55 to provide a seal between the piston 55 and the internal surface of the structure 59 and a further "O" ring 73 is carried by the structure 59 to provide a seal between the wall of the chamber 54 and the casing 71.

The left hand end of the chamber 57 is closed by a knock-open valve 74 including a piston 75. The piston 75 has a shaped end which seats against a complementary seating of the structure 59 to close an exit passageway 76.

In operation, the piston 56 is advanced to the left as shown in the drawing to compress the air present in the chamber 54 to cause the valve 62 to move to the right to close off chamber 54 from the atmosphere. As the piston 56 is further advanced within the chamber 54, so the member 66 is moved to the left against the action of spring 68 to allow air under pressure to flow through the bore 65 and into recompression chamber 57. The piston 56 continues to advance until it reaches the extent of its permitted movement at which time the face of the valve 62 lies in contact with or closely adjacent to the right hand side of the piston 55. Piston 56 is then partially retracted to cause the member 55 to move to the right to close off communication between chambers 54 and 57. As the pressure within chamber 54 falls to below atmosphere, so the valve 62 opens to allow air from the atmosphere to flow through passageway 63 into chamber 54. The piston 56 is then advanced once more towards piston 55 to move the piston 55 to the left to cause the pre-compressed air in chamber 57 to be re-compressed to a higher level than air in chamber 54. This last step can be repeated to provide even greater levels of air pressurisation within chamber 57.

On firing the air gun, the stem 77 is struck by the gun's firing mechanism to move the valve 74 off from its seating to re-compress further the air present in the chamber 57 and to enable the re-compressed air to flow via the passageway 76. The presence of a projectile in the firing chamber of the gun produces a higher build-up of air pressure in passageway 76 to act against the rear flange of piston 75 to cause chamber 57 to discharge completely.

It will be understood that the foregoing is merely exemplary of valve assemblies in accordance with the invention and that modifications can readily be made thereto without departing from the true scope of the invention.

## Claims

1. A valve assembly for supplying air under pressure to the firing chamber of an air gun, the assembly being characterised in that it includes a hollow cylindrical chamber which houses a slidable piston whose external diameter is slightly less than the internal diameter of the cylindrical chamber to define an airflow passage therebetween, means for admitting air under pressure to that portion of the chamber interior which lies to one side of the piston, means for causing the piston to move along the chamber immediately before release of the air from the chamber in a sense further to compress the air present therein, and means by which the re-compressed air can be selectively released from the cylindrical chamber to the firing chamber of the air gun.

2. A valve assembly as claimed in Claim 1 characterised in that the piston is biased towards one end wall of the chamber by a spring, movement of the piston caused by the firing mechanism automatically effecting further compression of the air present in the chamber.

3. A valve assembly as claimed in Claim 1 or Claim 2 characterised in that one end of the slidable piston is shaped to define a sealing surface with a complementary shaped surface of an end wall of the casing of the cylindrical chamber, spring means being provided to urge the sealing surface of the piston into close contact with the complementary surface of the chamber.

4. A valve assembly as claimed in any one of Claims 1 to 3 characterised in that the diameter of the slidable piston varies along the piston length, one end diameter of the piston being less than that of the other end diameter.

5. A valve assembly as claimed in any one of the preceding claims characterised in that the slidable piston includes an internal bore into which a second spring-biased slidable piston protrudes, means being provided to place the interior of the compression chamber in com-

munication with a space defined between the end of the bore remote from the chamber and the opposed end of the second piston.

6. A valve assembly as claimed in any one of Claims 1 to 4 characterised in that the slidable piston is carried by a spring-biased stem of a knock-open valve moveable by a firing mechanism of the air gun along the chamber.

7. A valve assembly as claimed in any one of the preceding claims characterised in that air under pressure is admitted to the chamber by a manually-operated pump.

8. A valve assembly as claimed in any one of Claims 1 to 6 characterised in that air under pressure is admitted to the chamber from a valve operated air pressure bottle.

9. A valve assembly as claimed in any one of Claims 1 to 4 wherein the slidable piston includes a leading end of reduced diameter which protrudes into an internal passageway of a fixed structure of the valve, means operable to propel the piston into and through the passageway towards an exit passageway for compressed air, and a knock-open valve biased by a spring to close off the exit passageway but moveable by a firing mechanism of the air gun to open the same.

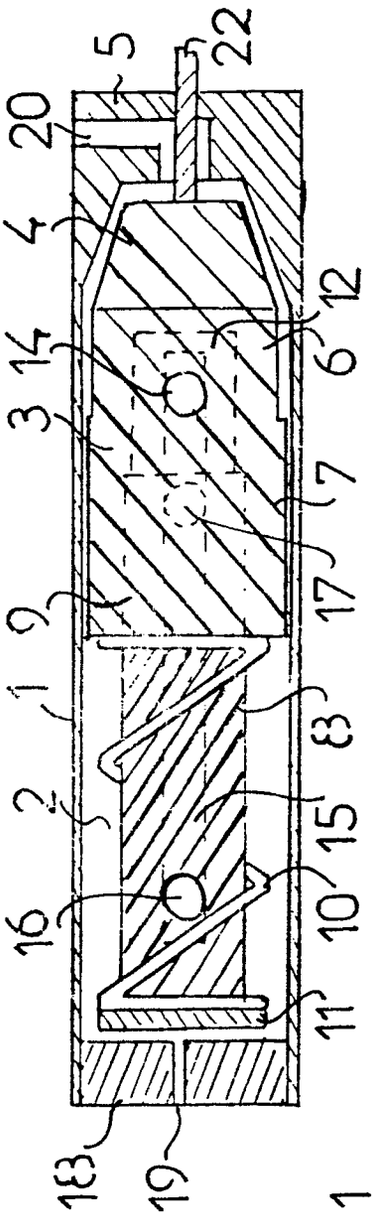


FIG.1

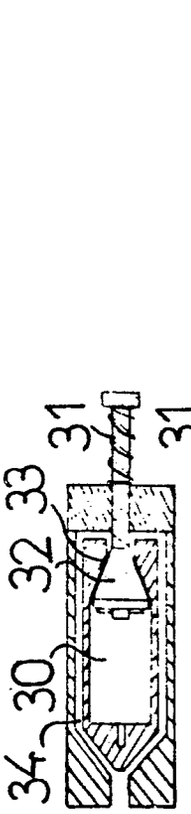


FIG.3

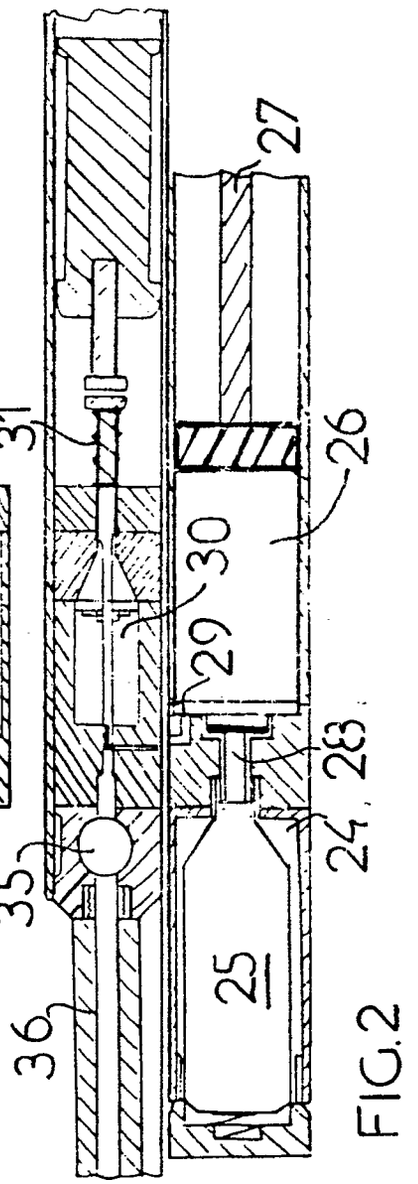


FIG.2

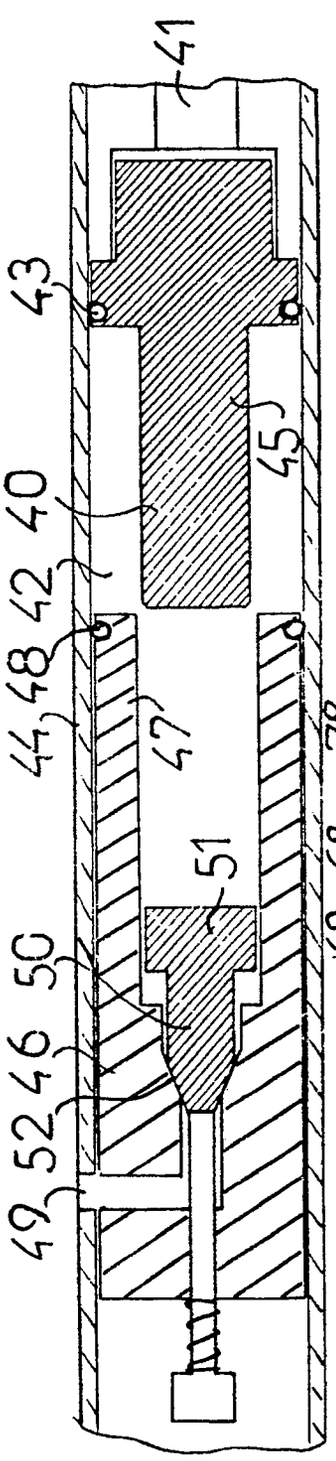


FIG.4

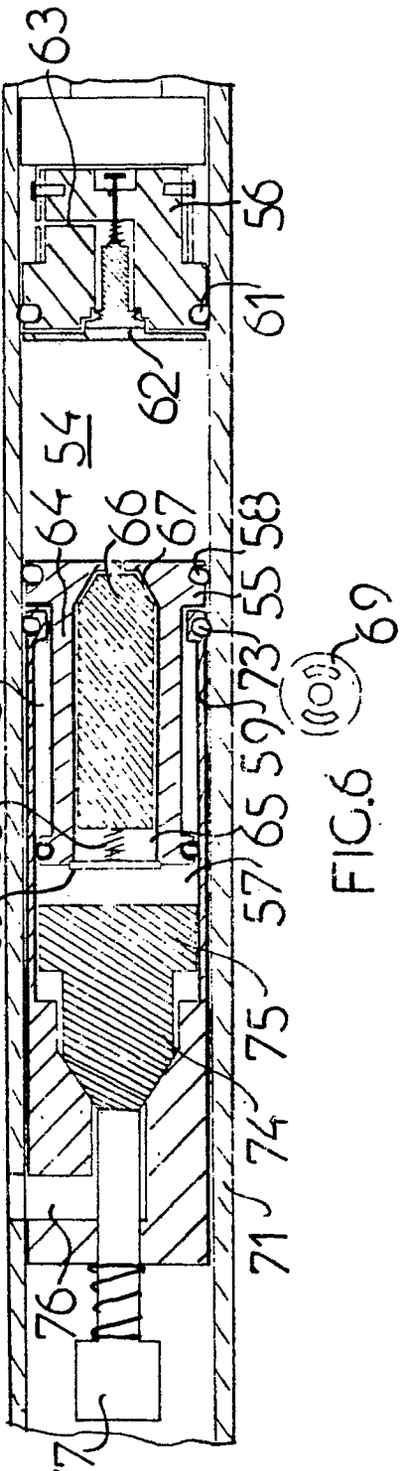


FIG.5

FIG.6