

[54] **AIR GUN AND NOZZLE THEREFOR**
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[52] **U.S. Cl.**..... 239/417.3, 239/DIG. 7, 239/425.5, 239/433
 [51] **Int. Cl.**..... **B05b 7/12**
 [58] **Field of Search**..... 239/425.5, DIG. 7, 419.5, 239/424.5, 433, 417.3

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[57] **ABSTRACT**

A nozzle for an air gun to provide an exiting stream of air from a source of pressurized air in which the nozzle has a through passageway and an intersecting slit with the pressure of the exiting stream being higher than in similarly constructed nozzles before reversal of flow occurs by directing the pressurized air through the slit in the direction of the exit and restricting the passageway entrance for the ambient air.

7 Claims, 3 Drawing Figures

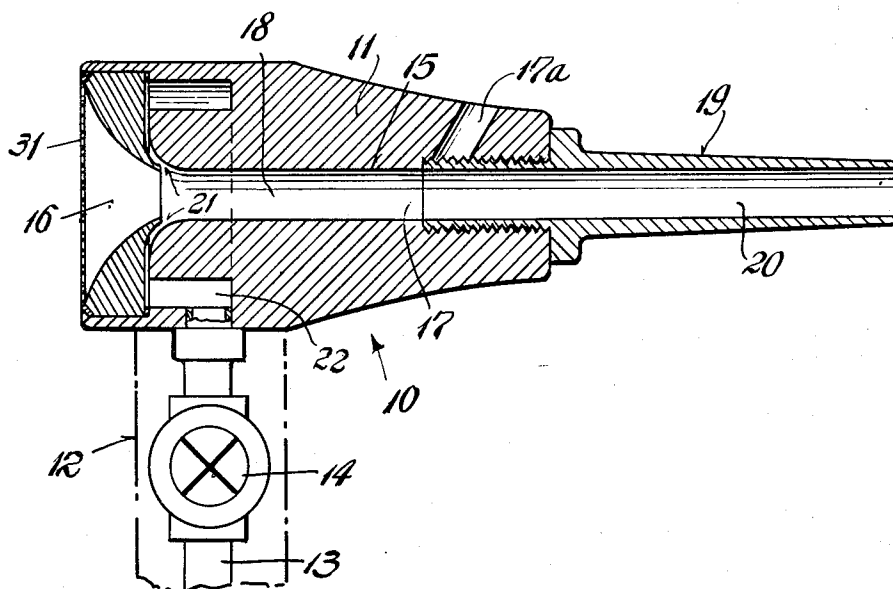


Fig. 1

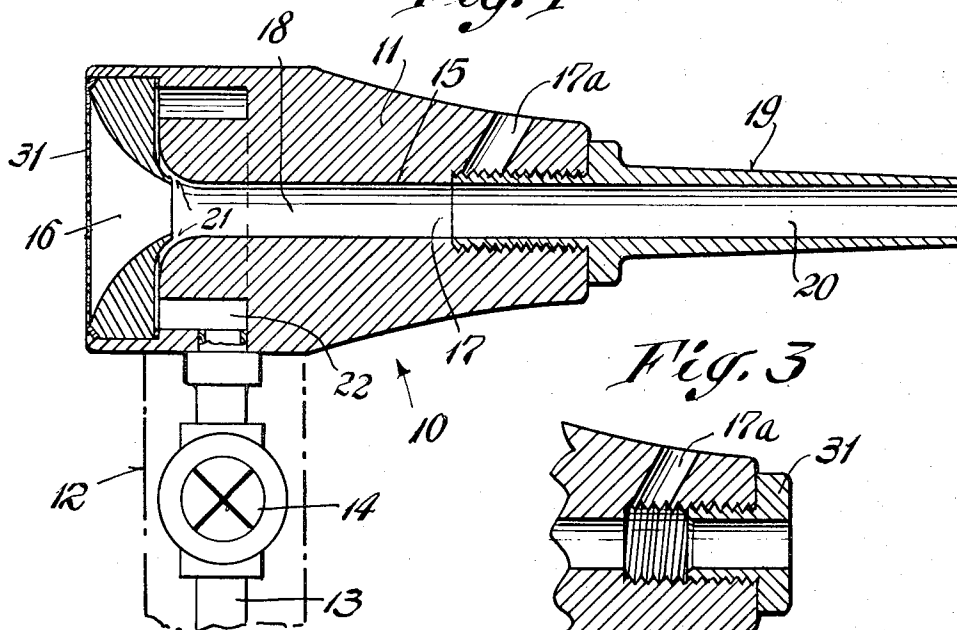


Fig. 3

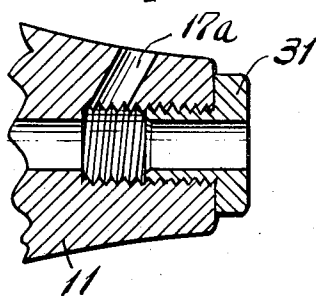
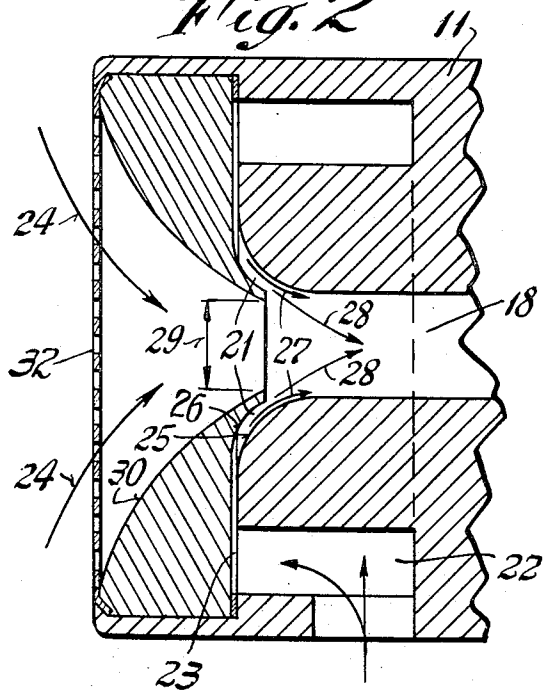


Fig. 2



AIR GUN AND NOZZLE THEREFOR

In my U.S. patent application, Ser. No. 234,535, now U.S. Pat. No. 3,743,186, granted July 3, 1973 assigned to the assignee of the present invention, there is disclosed an air gun that provides a stream of air which may be used, for example, in a machine shop for removing chips and particles from work. The gun has a nozzle formed to provide a through passageway with both ends being open and an intermediate slot intersecting the passageway. Pressurized air is introduced into the passageway through the slot and the passageway is shaped so that it uses the Coanda principle to draw ambient air into the entrance which combines with the pressurized air to form the exiting stream. The ratio of the ambient air to compressed air approximates 2 to 1 which makes it substantially more efficient than just a compressed air gun.

In such a gun, it has been found that only a small pressure on the order of 2-7 psi. can be made to exist at the exit, even when the pressurized air is at around 100 psi. When the exit is restricted or blocked, the exit pressure increases and the flow of air through the passageway reverses so that the compressed air flows out the passageway entrance. While this has been found to be extremely advantageous in making the gun efficient and conforming to safety standards, it has prevented its effective use in many applications that require a higher exit pressure.

It is accordingly an object of the present invention to provide a nozzle which may be used in an air gun which while producing a high exit pressure has its maximum blocked exit pressure less than that set by present safety standards.

Another object of the present invention is to provide an air gun that is substantially identical in construction to existing Coanda principle air guns and retains the reverse flow characteristics thereof even while producing the higher exit pressure.

A further object of the present invention is to provide an air gun that is extremely simple in construction, reliable and effective in use and economical to manufacture.

In carrying out the present invention, the nozzle differs from my previous nozzle in that it tends to function essentially as a compressed air gun rather than as a Coanda principle nozzle. Thus, throughout its operating range, the exiting stream ratio of ambient air to compressed air is substantially less than in a Coanda principle nozzle. However, the exit pressure at which complete reversal of flow occurs is substantially increased. This is achieved by making the entrance of the passageway smaller in cross-sectional area than the cross-sectional area of the passageway and by directing the flow of compressed air towards the exit. The smaller entrance, though minimizing flow of induced ambient air, does, however, increase the exit pressure that may exist before flow reversal but still enables reversal to occur to thereby set the maximum pressure that the gun can exert at its exit.

Other features and advantages will hereinafter appear.

In the drawing.

FIG. 1 is a diametrical, axial cross-section of the nozzle for an air gun of the present invention, somewhat enlarged.

FIG. 2 is a further enlarged section of the portion of the nozzle having the slot and entrance.

FIG. 3 is a partial sectional view of another embodiment of the exit portion of the nozzle.

Referring to the drawing, the air gun is generally indicated by the reference numeral 10 and includes a nozzle 11 and a handle 12, the latter being merely shown by dotted lines. Within the handle there is a conduit 13 having a valve 14 for controlling the flow of compressed air to the nozzle. For a more complete description of the handle and valve, reference is made to my above-noted copending application.

The nozzle 11 is formed to provide a through passageway 15, having an entrance 16, an exit 17 and an intermediate portion 18. In the embodiment shown in FIG. 1, a deep hole blowing attachment 19 is shown threadingly connected to the exit with the attachment being essentially a tube having a bore 20 that has a constant diameter which is about the same as the constant diameter of the intermediate portion 18. The nozzle has an air screen forming opening 17a which in this embodiment is desirably closed by the attachment 19.

A slot 21 communicates at one end with the passageway 15 and at its other end, with the conduit 13 by way of a ring-shaped conduit 22 and a disc-shaped conduit 23.

In use, the conduit 13 is connected to a source of compressed air which may be on the order of 100 psi. and the valve 14 is opened to permit passage of compressed air through the conduit 13, conduit 22, disc-shaped conduit 23, slot 21, intermediate portion 18, and either exit 17 or bore 20 to exit as a forceful stream therefrom. As explained in my prior application, this flow of compressed fluid also induces the flow of ambient air into the entrance 16 and through the passageway to exit with the compressed air with the flow of ambient air being indicated by the arrows 24. If the exit is restricted or blocked so that the pressure in the passageway increases, the compressed air will reverse itself and flow out the entrance.

The slot 21 is formed by a first curved surface 25 which curves from being transverse to the passageway to being essentially parallel with it where their merger occurs. The other surface 26 defining the slot is also curved from being transverse to the passageway to being essentially parallel thereto and preferably has a shape similar to the surface 25. Thus the slot from the disc-shaped passage to the passageway is at least of the same width so as not to provide any restriction in the flow of the compressed gas.

Some of the air through the slot follows the curve of the surface 25 and passageway as indicated by the arrows 27 while some simply exits as a jet into the interior of the passageway as indicated by the arrows 28. The compressed air flow thus has its force and momentum directed essentially towards the exit.

It has been found that an increase in the exit pressure before reversal can be obtained by decreasing the cross-sectional area of the entrance. Thus, as shown by the dimensional arrow 29, the smallest diameter of the entrance is made to be smaller than the diameter of the intermediate portion 18 of the passageway and be located adjacent the slot. A surface 30 that leads to the entrance is converging, as shown.

In one example of the present invention, the diameter of the portion 18 is 0.187 inches, the diameter of the entrance area is 0.156 inches and the bore 20 diameter

is 0.187 inches. These dimensions together with an inlet pressure of 100 psi. and a slot width of about 0.006 inches, enabled the nozzle to exert an exit pressure of about 25 psi. before reversal.

In use, for low exit pressures, the compressed air induces a small flow of ambient air so that the exiting stream is perhaps 80-85% compressed air and the remainder induced air. As the exit pressure increases some of the compressed air begins to somewhat also exit from the entrance until at the maximum exit pressure, all the flow of compressed air is through the entrance. Normally maximum exit pressure is achieved by completely blocking the exit.

The maximum reversal pressure may be changed by altering the cross-sectional area of the entrance with a lesser area providing a higher pressure and a larger area with a lesser pressure. As the exit pressures change the quantity of induced ambient air also changes but inversely thereto. It has been found that at least 10 percent reduction in size is needed to provide a significant increase in the value of the reverse exit pressure.

As shown in FIG. 3, if it is desired to have the air shield opening 17a be operable, a short attachment 31 may be used which does not block it.

It has been found helpful, both with diffusing reverse flow and preventing passage of particles into the entrance to provide a screen 32 thereat.

While reference has been made to air, it will be clear that the nozzle may be used with other gases.

While the slot herein described is annular, it will be appreciated that if desired, it may be formed with a plurality of disconnected portions, or openings if desired so long as they are shaped to achieve the above-described results.

It will be understood that the air gun of the present invention is identical to the air gun disclosed in my prior application except for the cap 33 that forms the surfaces 26 and 30. This includes the use of a washer in the disc-shaped conduit 23, which washer may form the conduit 23 into a plurality of segments, each individually connecting the ring-shaped conduit 22 to the slot 21.

It will accordingly be appreciated that there has been disclosed a nozzle for an air gun. The nozzle basically functions as just a compressed air gun but yet can only exert a maximum exit pressure that is substantially less than the pressure of the compressed air. This is achieved by first forming the slot so that the compressed gas exits somewhat as a stream having a direc-

tion towards the exit and also by reducing the size of the entrance to less than the nozzle passageway. By varying the size a maximum reversal pressure may be selected.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. A nozzle adaptable for use in an air gun for providing a stream of fluid comprising means forming a through passageway in the nozzle having an open entrance and exit and an intermediate portion therebetween, means forming a slot having one end intersecting the passageway adjacent the entrance and means adapted to connect the inlet of the slot to a source of fluid under pressure, said slot forming means shaping said slot to cause pressurized fluid therethrough to be structurally directed towards the exit and means for restricting the size of the entrance to less than the size of the passageway adjacent the slot, whereby the nozzle may tolerate a higher exit pressure before reversal of flow.

2. The invention as defined in claim 1 in which the slot forming means includes a first surface that curves toward the exit from being transverse to the passageway to merge with the passageway and a second surface that is spaced slightly from the first surface and also curves toward the exit with the surfaces being essentially similarly shaped.

3. The invention as defined in claim 2 in which the curved surfaces maintain at least the same spacing therebetween to obviate a restriction to the flow of fluid.

4. The invention as defined in claim 3 in which the curved surfaces somewhat diverge to increase the space therebetween as the surfaces curve towards the passageway.

5. The invention as defined in claim 1 in which the entrance is formed by converging surfaces that include a portion which has a smaller cross-sectional area than the intermediate portion.

6. The invention as defined in claim 5 in which the smaller cross-sectional area is located adjacent the slot.

7. The invention as defined in claim 1 in which the open intersection between the slot and the passageway is annular.

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