

[54] **PNEUMATIC PERCUSSIVE TOOL**

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[51] **Int. Cl.**..... **B25d 9/04**

[58] **Field of Search** **173/162, 168, 169, 170, 173/139, DIG. 2; 181/36 A**

[56] **References Cited**

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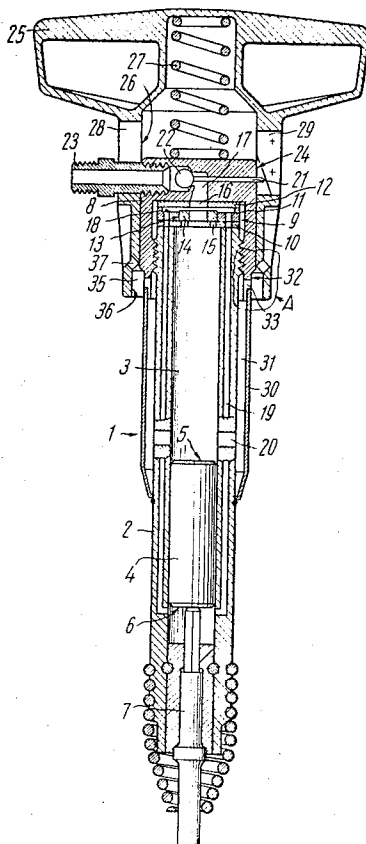
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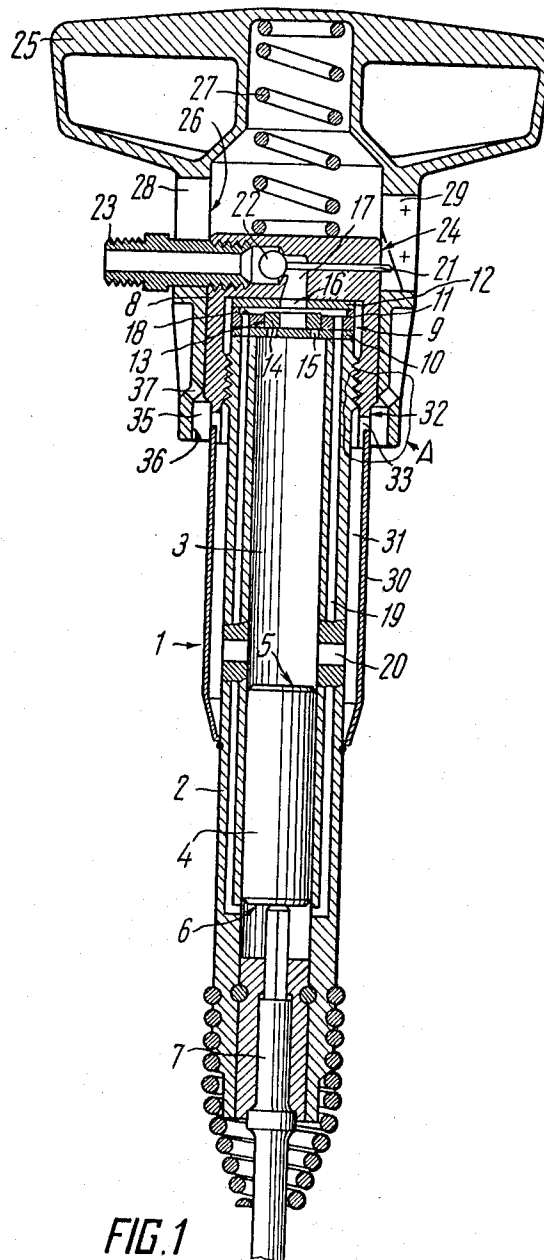
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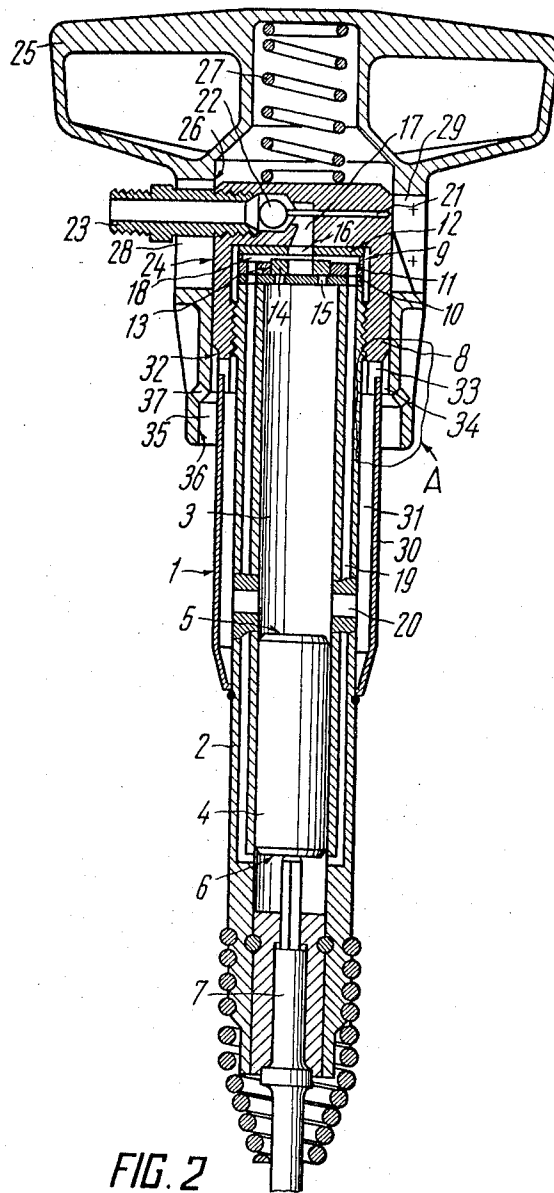
ABSTRACT

A pneumatic tool for lowering aerodynamic noise generated during operation thereof and comprising a cylinder, a hammer accommodated in the cylinder, a casing mounted on the cylinder forwardly of the housing and defining together with the cylinder and the front end portion of the housing a manifold adapted to collect the exhaust air, a handle mounted on the housing for axial movement along the housing within certain limits, and a shock absorber disposed between the housing and the handle. The front end part of the housing is externally provided with a portion of outside diameter smaller than that of the surface of the housing in contact with the handle and which is substantially equal to the outside diameter of the housing. The inner surface of the handle is also provided in the front end part with a portion of diameter greater than the diameter of the surface thereof in contact with the housing. Upon the exertion of a pressure upon the handle and during its movement along the housing the above portions define two serially disposed cavities communicated therebetween, the rear end cavity, which has a smaller cross-sectional area, communicating with the manifold, while its front end portion communicates with the other cavity, front end cavity, which has a greater cross-sectional area and is open to atmosphere with its front end portion. Furthermore, the rear end portion of the front end cavity communicates with atmosphere through passages in the wall of the handle.

2 Claims, 5 Drawing Figures







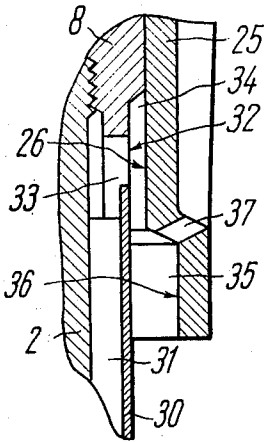


FIG. 4

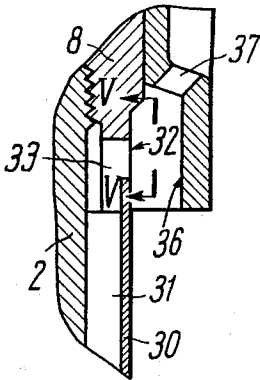


FIG. 3

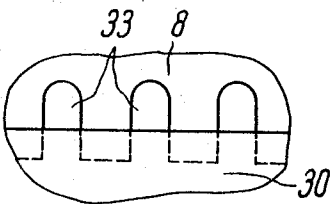


FIG. 5

PNEUMATIC PERCUSSIVE TOOL

BACKGROUND OF THE INVENTION

The present invention relates to pneumatic percussive tools, and more particularly to concrete breakers and the like which may be used in the building industry, for municipal works, as well as in the mining industry, metallurgy, etc.

A pneumatic percussive tool is known in the art, comprising a cylinder accommodating a hammer adapted to reciprocate under the action of compressed air and to impart blows to a working implement received in the front end portion of the cylinder, a housing mounted on the rear end portion of the cylinder, a casing mounted on the cylinder forwardly of the housing and defining together with the cylinder and the front end part of the housing a manifold adapted to accumulate the exhaust air, a handle mounted on the housing and axially movable along the peripheral surface of the housing within certain limits, and a shock absorber disposed between the housing and the handle.

In this known tool the exhaust air is discharged from the manifold directly to the atmosphere. Thus a strong aerodynamic noise is generated which adversely affects the health of workers and people in the vicinity of the operating tool.

Furthermore, dust from the material being broken, which is formed during the operation of the tool, ascends to the level of the operator's face and penetrates into the respiratory system thereby adversely affecting his health.

Numerous attempts have been made to lower the level of aerodynamic noise during the operation of pneumatic percussive tools, one of which is disclosed in Swedish Pat. No. 215,003.

The pneumatic percussive tool disclosed in that patent comprises a housing with an impact mechanism, a working implement received in the front end portion of the housing and a muffler mounted on the housing and adapted to collect the exhaust air and to discharge it to atmosphere. A special damping material in the muffler reduces the aerodynamic noise from the exhaust air jet.

The disadvantages of this known tool consist in complicated structure and large size, poor maneuverability in operation, lower capacity of the tool with the exhaust air passing through the muffler, and dust formation at the working area.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a pneumatic percussive tool which generates lower noise during operation.

Another object of the invention is to provide a pneumatic percussive tool having simple structure.

Still another object of the invention is to provide a pneumatic percussive tool which reduces dust formation at the working area.

These and other objects are accomplished by the provision of a pneumatic percussive tool comprising a cylinder accommodating a hammer adapted to reciprocate under the action of compressed air and to impart blows to a working implement received in the front end portion of the cylinder, a housing fixed on the rear end

portion of the cylinder, a casing mounted on the cylinder forwardly of the housing, the casing defining together with the cylinder and the front end portion of the housing a manifold adapted to collect exhaust air, housing a handle mounted on the housing and axially movable along the peripheral surface of the housing within certain limits, and a shock absorber disposed between the housing and the handle. According to the invention the housing is externally provided at its front end with at least one portion of a diameter, which is smaller than that of the surface thereof in contact with the handle, the diameter being substantially equal to the outside diameter of the rear end portion of the casing, while the inner surface of the handle at its front end is also provided with at least one portion of a diameter, which is greater than that of the surface thereof in contact with the housing. The above-mentioned portions define two serially disposed annular cavities communicated therebetween upon the exertion of pressure upon the handle and during the movement thereof along the housing into the operative position, the rear end cavity communicating with the manifold, while the front end cavity, which has a greater cross-sectional area, being open into atmosphere with its front end portion and being in addition open to atmosphere at the rear end portion thereof through at least one passage in the wall of the handle.

The rear end cavity preferably communicates with the manifold through slots in the front end face of the housing, these slots being partially closed by the rear end portion of the casing, whereby the structure of the casing, housing and cylinder is simplified.

It is also advantageous that the slots in the front end face of the housing and the passages in the handle wall, which establish communication between the rear end portion of the front end cavity and atmosphere, be arranged substantially in one and the same longitudinally extending plane, whereby the maximum possible speed reduction of the exhaust air leaving the tool is achieved.

The invention provides a pneumatic percussive tool exhibiting considerably lower aerodynamic noise in operation, as well as substantially reduced dust formation at the working area. It should be noted that the tool is modified the simplest way without introducing additional parts, but with mere modification thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the specific embodiment thereof illustrated in the accompanying drawings, in which:

FIG. 1 shows a pneumatic percussive tool in longitudinal section and the idle position, according to the invention;

FIG. 2 is ditto, in the operating position;

FIG. 3 is detail A in FIG. 1;

FIG. 4 is detail A₁ in FIG. 2;

FIG. 5 is a sectional view taken along the line V—V in FIG. 3.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the description of the specific embodiment illustrated in the accompanying drawings specific terms of the art are used. It should be noted, however, that each term covers all the equivalent members functioning in the same manner and used for the same purposes.

The pneumatic percussive tool shown in FIGS. 1 to 5 comprises a body 1 including a cylinder 2 accommodating in its cylindrical bore 3 a slidable hammer 4 sealed over the outer surface thereof and adapted to reciprocate under the cyclical action of compressed air upon its end faces 5 and 6.

The cylinder 2 has in its front end portion a removably fixed working implement 7 resting against the material being demolished (not shown).

A housing 8 is mounted in the known manner on the cylinder 2, and an air-distribution means 9 is disposed between the bottom wall of the housing and the rear end face of the cylinder 2, said means being adapted to alternatively deliver compressed air into the front end and rear end portions of the bore 3.

The air-distribution means 9 comprises a front end seat 10, a valve box 11 and a rear end seat 11. A cylindrical bore 13 of the box 11 accommodates a slidably mounted valve member 14 sealed over its outer surface and comprising a ring. The valve member 14 rests against the front end seat 10, and the end face of the valve member closes ports 15 in the front end seat 10, which ports 15 establish communication between the bore 13 and bore 3 of the cylinder 2 in the rear end portion thereof. The rear end seat 12 is provided with a port 16, which establishes communication between the bore 13 and a passage 17 disposed in the bottom wall of the housing 8. A bore 18 is disposed in the rear end face of the box 11, the bore 18 communicating through passages 19 made in the box 11, the front end seat 10 and the walls of the cylinder 2 with the bore 3 of the cylinder 2 in the front end portion thereof. The bore 18 also communicates with the bore 13 and the passage 17 through an annular space between the valve member 14 and the rear end seat 12. Exhaust ports 20 are formed in the walls of the cylinder 2.

The bottom wall of the housing accommodates a pusher 21 and a ball 22 closing the passage 17. The bottom wall of the housing also mounts a pipe connection 23 adapted to receive in the known manner an air supply hose (not shown). A handle 25 is fixed on the housing 8, the handle being axially movable along the housing 8 within certain limits, the peripheral surface 24 of the housing being in contact with the surface 26 of the handle 25.

A spring (shock absorber) 27 is disposed between the handle 25 and the housing 8 in coaxial relation therewith.

A longitudinally extending closed groove 28 is made in the wall of the handle 25, the pipe connection 23 passing through that groove. The groove and the pipe connection cooperate therebetween so as to limit the movement of the handle 25 along the housing 8.

A wedge 29 is fixed in the wall of the handle 25 in the known manner, the wedge acting by means of the pusher 21 upon the ball 22 to displace it in the direction of the air delivery to the tool upon the forward movement of the handle 25.

A casing 30 is mounted on the rear end portion of the cylinder forwardly of the housing, the casing defining together with the outer surface of the cylinder 2 and the front end portion of the housing 8 a manifold 31 adapted to collect the exhaust air. The rear end face of the casing 30 rests against the housing 8 which is provided at its front end with a portion 32 of a diameter, which is smaller than that of the surface 24. The diame-

ter of the portion 32 and the outside diameter of the casing 30 are equal.

A plurality of slots 33 are formed in the front end face of the housing 8, one slot being adapted to receive a pin fixing the housing 8 relative to the cylinder 2. The slots 33 (FIG. 3) are also extended beyond the end of the casing 30 and are used as the outlet ports of the manifold 31, whereby the structure of the casing, housing and cylinder is simplified.

The inner surface of 26 of the handle 25, the surface of the portion 32 and the outer surface of the casing 30 define a rear end cavity 34 of an annular cylindrical shape during the movement of the handle 25 toward the foremost position.

The rear end cavity 34 communicates with its front end portion and over the entire cross-sectional area thereof with a front end cavity 35, which is defined by the outer surface of the casing 30 and the surface of a portion 36 made in the handle 25 at the front end thereof. The diameter of the portion 36 is greater than that of the surface 26 of the handle 25. The front end cavity 35 is open toward the front end part of the tool, that is toward the material being demolished, over the entire cross-sectional area thereof, which is greater than the cross-sectional area of the rear end cavity 34. With its rear end portion the front end cavity 35 communicates with atmosphere through passages 37 made in the wall of the handle 25, the passages 37 being disposed in one and the same longitudinally extending plane with the slots 33.

The tool functions as follows.

Referring to the initial position shown in FIG. 2, the hammer 4 is in a thrust position against the working implement 7, while the handle 25 is pressed upon and is displaced from its rearmost position into some intermediate position. Accordingly, the wedge 29 acts through the pusher 21 upon the ball 22 in the direction of the delivery of compressed air to the tool, and the passage 17 is now open. Compressed air from a source thereof is fed through an air supply hose (not shown), the pipe connection 23, the passage 17 and the port 16 into the bore 13. Then the compressed air is fed from the bore 13 through the space between the rear end seat 12 and the valve member 14 and through the bore 18 and the passages 19 into the front end portion of the bore 3 of the cylinder 2. The compressed air then acts upon the surface 6 of the hammer 4, while the surface 5 thereof is under the atmospheric pressure since the exhaust ports 20 are open. The hammer 4 begins to move toward the rear end part of the tool under the action of the resulting pressure difference.

During its movement the hammer 4 closes the exhaust ports 20 and cuts off the rear end portion of the bore 3 from the atmosphere, and compression of the air entrapped in that portion of the bore will take place.

During its further movement the hammer 4 opens the exhaust ports 20, and the compressed air is exhausted from the front end portion of the bore 3 through the ports 20 into the manifold 31.

The exhaust air entering the manifold 31 fills up the entire volume thereof and flows into the slots 33. The air then flows through the slots 33 into the rear end cavity 34 to move therealong toward the front end part of the tool. The exhaust air flows from the rear end cavity 34 into the front end cavity 35 and further there-through into atmosphere through the open end of the cavity 35. The air flows out of the rear end cavity 34

into the front end cavity 35 in the form of a viscous turbulent jet, and it is known that such a jet can suck the ambient air thereinto. The ambient air is sucked through the passages 37. Since the jet has a certain momentum, an increase the mass of air due to the suction in of the ambient air results in a reduction of the discharge speed at the output of the front end cavity 35. It is also known that the noise intensity from an exhaust jet is directly proportional to its speed. It will be apparent that the reduction of the discharge speed will result in lower aerodynamic noise.

The arrangement of the slots 33 and the passages 37 in one and the same plane permits the final discharge speed to be reduced to the maximum possible degree by ensuring the suction of the ambient air directly into the central portion of each jet.

The exhaust air jet is directed toward the material being demolished upon leaving the front end cavity 35, whereby the dust is prevented from moving toward the face of the operator.

Upon exhaust of the compressed air from the front end of the bore 3 the pressure therein will fall substantially to atmospheric, and thereby the pressure will also be reduced in the passages 19, the bore 18 and in the space between the rear end seat 12 and the valve member 14.

During further movement under inertia the hammer 4 will compress the air entrapped in the rear end portion of the bore 3, and the pressure in that bore and in the ports 15 will be increased. After the pressure force acting upon the front end face of the valve member 14 from the ports 15 exceeds by the absolute value the pressure force acting upon its rear end face, the valve member 14 will move toward the rear end seat 12 and will come in contact therewith. The passage 17 will be thus isolated from the passage 19, and the compressed air flow through these passages will be cut off. Upon moving toward the rear end seat 12 the valve member opens the ports 15, and the compressed air begins to flow through these ports and through the bore 13 into the rear end portion of the bore 3.

The hammer 4 will be decelerated under the action of the air, which is compressed in the rear end portion of the bore 3, as well as under the action of fresh air entering through the ports 15, and will begin to move in the opposite direction toward the working implement 7.

After the exhaust ports 20 have been closed by the hammer 4, the compression of the air entrapped in the front end portion of the bore 3 takes place.

During its further forward movement the hammer 4 will open the exhaust ports 20, and the compressed air will again be exhausted from the rear end portion of the bore 3 through said ports 20 and the manifold 31.

Also in this case the exhaust compressed air flows from the manifold 31 through the slots 33 into the rear end cavity 34 and therealong toward the front end part of the tool. The exhaust air flows from the rear end cavity 34 into the front end cavity 35 and therefrom to the atmosphere.

As was mentioned previously, the air flows from the rear end cavity 34 into the front end cavity 35 in the form of a viscous turbulent jet which can suck the ambient air thereinto through the passages 37. The action of the ambient air reduces the discharge speed from the front end cavity 35 thereby resulting in lower aerodynamic noise.

Upon exhaust of the compressed air the pressure in the rear end portion of the bore 3 is reduced substantially to atmospheric. The pressure will be reduced in the ports 15 and the space between the valve member 14 and the front end seat 10. The pressure between the valve member 14 and the rear end seat 12 will be increased due to the compression of free air in the front end portion of the bore 3, this pressure being transmitted into the bore 18 through the passages 19. At the instant, when the pressure forces acting upon the rear end face of the valve member 14 exceed by an absolute value the forces acting upon the front end face thereof, the valve member 14 will move toward the front end seat 10 to close the ports 15. The compressed air will begin to flow through the space between the valve member 14 and the rear end seat 12, the bore 18 and the passages 19 into the front end portion of the bore 3.

The hammer 4 will impart a blow to the working implement 7 by its surface 6, while overcoming a back pressure acting upon that surface.

Upon the delivery of a blow the hammer will move in the opposite direction from the working implement 7 under the action of compressed air upon the surface 6 and as a result of the recoil from the working implement 7. The cycle will be repeated.

It should be noted that the embodiment of the invention illustrated in the drawings and hereinabove described represents but a preferred embodiment of the invention. Various modifications may be made as to the shape, size and mutual arrangement of certain elements. Thus, the parts shown in the drawings and described hereinabove may be substituted for by their equivalents, the position of some parts may be changed and some elements of the invention may be used independently of the others without departing from the spirit and scope of the invention as set up in the appended claims.

Tests of a pneumatic concrete breaker constructed according to the invention have confirmed its advantages described hereinabove. The frequency response of noise was considerably improved, and the total noise level was lowered. There were no decrease in other parameters of the concrete breaker (single impact energy, frequency of blows, air consumption).

What is claimed is:

1. A pneumatic percussive tool comprising: a cylinder having an upper end portion and a lower end portion; a hammer disposed in said cylinder for reciprocating movement therewithin under the action of compressed air, therewith to impart blows to a working implement received in the front end portion of said cylinder; air-distribution means, said means being connected to a source of compressed air during the operation of the tool, and disposed in the rear end face of the upper end portion of said cylinder for distributing the compressed air provided from the source; a housing fixedly mounted on the rear end portion of said cylinder, for rigidly holding said air-distribution means to said cylinder, at least one portion of the peripheral surface of the front end of said housing having a different diameter, than the other, while the front end face of said front end of said housing is provided with slots; handle means mounted on said housing and axially movable along the outer surface of said housing between a maximum predetermined forward position and a maximum predetermined rearward position, said han-

dle means being provided on the inner surface of the front end part thereof with at least one portion having a diameter which is greater than that of the surface thereof in contact with said housing, and in the wall of the rear end part of that portion with through passages communicating with atmosphere, said handle means being provided for controlling said tool and permitting communication between said air-distribution means and said source upon movement thereof forwardly along the housing towards said maximum predetermined position into the operative position of the tool; a casing mounted on said cylinder forwardly of the housing, the outside diameter of the rear end portion of the casing being substantially equal to the outside diameter of said portion of said housing, said casing defining together with said cylinder and the front end portion of said housing a manifold for collecting the exhaust air; a shock absorber disposed between said housing and said handle for returning said handle towards said maximum predetermined rearward position into the rearmost inoperative position of the tool and reducing vibration of the handle; said portion of the housing having a diameter smaller than that of the surface of said housing mounting said handle; rear end and front end cavities defined by the axial movement of the handle along the housing towards said maximum predetermined forward position into the foremost operating position, the rear end cavity communicating with said

manifold through said slots formed in the front end face of said housing and being defined by said portion of the housing, the inner surface of said handle and the outer surface of the rear end portion of said casing, and said front end cavity communicating with its rear end portion through the front end portion of said rear end cavity, as well as with atmosphere through said passages of the handle, said front end portion also communicating with atmosphere through its open front end portion, which front end portion has a greater cross-sectional area than that of said rear end cavity and is defined by said portion of the handle and the outer surface of said casing so that upon entry of the exhaust air from said manifold into said rear end cavity and into said front end cavity communicated therewith and having a greater cross-sectional area the ambient atmospheric air is sucked in through said passages in the handle walls, whereby the speed of air discharge from said front end cavity is reduced thereby lowering the aerodynamic noise.

2. A pneumatic tool according to claim 1, wherein the slots in the front end face of the housing and the passages in the handle wall, which establish communication between the rear end portion of the front end cavity and atmosphere, are arranged substantially in one and the same plane.

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