This invention relates to pneumatic tools having exhaust noise reducing means and more particularly to rotary air motor powered tools and actuators in which the noise reduction is performed by a sound absorbing member of relatively rigid porous material such as sintered bronze.

Pneumatic tools have been provided with a member or ring of porous sintered bronze across the exhauster air passage or passages from the rotary air motor in the tool housing. These members or rings have hitherto been mounted to present a single integral porous barrier to the exhauster air stream but the noise reducing action thus achieved is usually insufficient particularly when such barrier has its outer face open directly to the ambient atmosphere. The efforts to improve noise reduction markedly by increasing the thickness of the barrier or changing its geometrical shape have been unsuccessful. As an alternative, the barrier has therefore been mounted internally of the tool with exhaust expansion passages and chambers extending downstream thereof to the atmosphere and providing additional noise reduction. This solution is constructionally complicated and costly and makes replacement and cleaning of clogged noise reducing members inconvenient.

The primary object of the invention is to provide a pneumatic tool or actuator with improved exhaust noise reducing means in direct communication with the atmosphere and capable of a very high degree of noise reduction. Another object of the invention is to provide simplified easy access to the noise reducing elements of such improved noise reducing means. A further object of the invention is to provide improved noise reducing means convenient and simple in application on tools with forwardly as well as rearwardly or laterally directed exhaust.

For these and other purposes there is provided in a pneumatic tool a generally cylindrical housing, a rotary air motor mounted within said housing, a cylindrical annular exhauster funnel in said housing and coaxial therewith, air exhauster passages longitudinally disposed within the housing connecting the outlet side of said air motor with one end of said funnel, said funnel having opening means communicating directly with the atmosphere at its end opposite to said exhauster passage, at least two noise reducing rings of porous sintered material mounted in axially stacked relation in and across said funnel for reducing the noise of the exhauster air passing from said exhauster passages through said funnel to the atmosphere, and means in said funnel for keeping said rings axially spaced in said funnel under the formation of a substantially annular expansion chamber for the exhauster air adjacent at least one of the axial faces of each ring in said funnel for increasing the noise reduction therein.

The above and other objects of the invention will become obvious from the following description and from the accompanying drawings in which five embodiments of the invention are illustrated by way of example. It should be understood that these embodiments are only illustrative of the invention and that various further modifications may be made within the scope of the claims.

In the drawings FIG. 1 is a partially sectioned side elevation view of a pneumatic tool incorporating the exhaust noise reducing means of the present invention, FIG. 2 is a sectional view taken on the line 2-2 of FIG. 1, FIG. 3 is a perspective view of a noise reducing insert included in the noise reducing means shown in FIG. 1, FIG. 4 is a fragmental sectional view of a noise reducing means of modified construction incorporating three noise reducing inserts. FIG. 5 is a sectional view taken on the line 5-5 of FIG. 1. FIG. 6 is a partially sectioned side elevational view of a pneumatic tool including a modified disposition of the noise reducing means of FIG. 1. FIG. 7 is a partially sectioned side elevational view of a pneumatic tool including another disposition of the noise reducing means. FIG. 8, finally, is a fragmental sectional view of a still further modification of the noise reducing means.

In the embodiment illustrated in FIGS. 1-3 and 5, the pneumatic tool chosen for illustration is a pneumatic screw driver 10 powered by the usual rotary vane motor. Compressed air enters through a threaded bushing 11 located at the rear end of the tool 10 and passes via a supply passage 12 into a valve chamber 13. A spring pressed valve 14 positioned within the tool 10 with its stem extending therefrom to be actuated through a hand operated lever 15 controls the flow of air from the chamber 13 into a passage 16 which is in flow communication with inlet passage means 17 in a cylinder 20 forming the motor cylinder of the rotary vane type motor of the tool 10. In a manner well known in the art the cylinder 20 has provided therein a rotor 21 in which a plurality of vanes 22 are radially mounted in radial grooves 23. In the cylinder 20 compressed air entering the inlet passage means 17 successively acts against the vanes 22 to rotate the rotor 21 around its axis. The working air expands and moves the vanes 22 in peripheral direction passing from the inlet passage means 17 to outlet passage means 25 which are in flow communication with an annular external recess 26 in the tool 10. From the recess 26 a plurality of exhaust passage means 27 extend axially to the rear of the tool 10 terminating adjacent one end of a cylindrical outer surface 28 forming part of the tool 10 and disposed around the threaded end of the inlet bushing 11. A radial shoulder 29 intersecting the exhaust passage means 27 is provided adjacent to the surface 28.

The central portion 30 of the tool 10 forms a cylindrical hand grip portion whereby the tool 10 can be grasped manually with the operator's hand in convenient position for actuating or releasing the lever 15 of the valve 14. With the lever 15 depressed and consequently the valve 14 open, the compressed air causes the rotor 21 to rotate and through suitable gears and transmission axles, not shown, the rotor 21 produces power rotation of a screw driver 31 in a manner well known in the art.

The exhaust air passed to the shoulder 29 would normally emit an objectionable high pitched operating noise to the ambient atmosphere and exhaust noise reducing means are therefore provided axially of the exhaust passage means 27. An open ended sleeve 32 having an inverted annular flange 34 thereon is mounted around and in spaced parallel relation to the outer surface 28 with the flange 34 resting against the shoulder 29. The internal aperture of the flange 34 is disposed radially outwardly of the passage means 27 and the sleeve 32 thus defines an exhaust funnel around the surface 28 connecting the exhauster passages 27 to the atmosphere. At least two axially spaced noise reducing rings 36 are mounted in stacked relation in and across the fan chamber 30 within the sleeve 32. The rings 36 are rectangular in cross section and of relatively rigid porous material, preferably porous sintered bronze. The axial spacing between the rings 36 is preferably provided by axial lugs 37 formed integral with each ring 36 at the one axial face thereof, FIG. 3. As shown in FIG. 1 the inner ring 36 is supported by the flange 34 of the sleeve 32 and the lugs of the outer ring 36 are resting directly against the inner ring 36. Substantially uninterrupted annular expansion...
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3 chambers are formed for the exhaust air adjacent at least one of the axial faces of each ring 36. This improves to a substantial degree the total noise reduction produced by the present noise reducing means.

Removable abutment means are provided on the outer surface 28 consisting of a resilient split ring 38 received in a groove 39 in the surface 28 in a position to keep the rings 36 stacked within the sleeve 32 and on the flange 34 thereof and with the flange 34 resting against the shoulder 29.

In the modification shown in FIG. 4, there are provided three porous rings 40 preferably of sintered bronze in the tunnel formed between the outer cylindrical surface 28 and the sleeve 32. These rings 40 are rectangular in cross section but without the lugs 37 shown in FIG. 3. Instead, the axial spacing for purposes of creating annular expansion chambers between the rings 40 is provided by cylindrical spacing sleeves 41 inserted between each ring 40 and between the innermost ring 40 and the flange 34. The sleeve 32, the rings 40, and the spacing sleeves 41 are secured in place against the shoulder 29 by a split ring 38 disposed as before in a groove 39 at the outer end of the surface 28.

In the two embodiments according to FIGS. 1–5 the rings 36, 40 can easily be replaced when clanged simply by axial removal of the sleeve 32 upon removal of the resilient ring 38 and the bushing 11, thereafter a sleeve 32 with a cleaned set of rings therein can be slipped in place against the shoulder 29 and locked by the ring 38.

In the embodiment according to FIG. 6 the pneumatic tool 10 is a hand drill carrying rotatably a drill chuck 42 at the forward end thereof. As shown in this figure the forward end of the rotor 21 is mounted to cooperate with planetary gearing 43, 44 in order to produce the desired rotational speed reduction of the chuck 42. The tool 10 carries a front over sleeve 46 threaded to the forward end thereof and the inner end of the cover sleeve 46 for an abutment 47 for securing noise reducing means similar to the means embodied in FIG. 1 against a shoulder 29 and around a reduced cylindrical outer surface 28 provided at the forward end of the tool 10. A flanged sleeve 32 rests with its flange against the radial shoulder 29 and carries stacked noise reducing inserts 36 of relatively rigid material therein having integral lugs 37 for the axial spacing therebetween and between the flange of the sleeve 32. The sleeve 32 and its inserts 36 are secured in place between the abutment 47 and the shoulder 29. The outlet passage means 25 from the motor cylinder 20 extend in forward direction communicating with the integral space around the planetary gearing 43, 44 from which the exhaust passes radial bores 50 to the inner end of the exhaust tunnel inside the sleeve 32 and thence through the inserts to the ambient atmosphere in forward direction. Such forwardly directed exhaust can be chosen for work of a character permitting air to be blown past the parts operated upon by the tool. For finer work and particularly when deposition of oil droplets is undesirable, it is preferred to use the rearwardly directed exhaust disclosed in connection with FIGS. 1 and 4.

In the embodiment according to FIG. 7 the exhaust noise reducing means are similarly to the embodiment depicted in FIG. 5 disposed adjacent the central gripping portion 30 of the tool 10 but are directed to provide rearward exhaust. The surface 28 and the shoulder 29 are therefore disposed at the rear end of the central portion 30 and outlet passage means 25 from the cylinder 20 extend rearwardly to radial through bores 50 adjacent the shoulder 29. The sleeve 32 with its rings 36 is kept against the shoulder 29 by a flange 51 on a rear housing 52, which is threaded into the rear end of the central portion 30. The bushing 11, the passages 12 and 16, the valve 14 and its lever 15 are all provided in connection with the rear housing 52 and are identical in operation with the corresponding details in the embodiment depicted in FIG. 1. Replacement of the noise reducing means can obviously be performed by unscrewing the housing 52 from the rear end of the central gripping portion 30 of the tool 10.

The embodiment of the noise reducing means of the tool or actuator 101 showed in FIG. 6 incorporates a modified sleeve 23 resting with one end thereof against the shoulder 29 while being provided with an annular inner flange 53 at the opposite end thereof. The flange 53 fits snugly around the surface 28 and cooperates with the locking abutment provided by the split resilient ring 38 in its groove 39 for keeping the sleeve fixed against the shoulder 29. As in the other above described embodiments there are stacked axially spaced noise reducing rings 36 of porous material, preferably sintered bronze, within the sleeve 32 and provided with axial spacing means such as lugs 37, FIGS. 3 and 7. Adjacent the flange 53 there are provided radial outlet openings or slots 54 in the sleeve 32 so that the exhaust will be directed radially outwardly and laterally relative to the tool 10. An additional spacing sleeve 55 may be provided around the surface 28 between the outermost ring 36 and the flange 53.

What I claim is:

1. In a pneumatic tool a generally cylindrical housing, a rotary air motor mounted within said housing, a cylindrical external surface on said housing with one end thereof terminating in an annular shoulder radially outwardly of said surface, air exhausted from said shoulder longitudinally disposed within the housing connecting the outlet end of said air motor with the end of said external surface adjacent said shoulder, a sleeve extending from said shoulder in substantially parallel spaced relation to said external surface, opening means in said sleeve communicating directly with the atmosphere at the end of said sleeve opposite to said shoulder, a plurality of noise reducing rings of relatively rigid porous material mounted in axially stacked relation between said external surface and said sleeve for supporting said sleeve around said surface and for reducing the noise of the exhaust air issuing from said exhaust passages through said sleeve to the atmosphere, and means in said sleeve for keeping said rings axially spaced therein under the formation of a substantially annular expansion chamber for the exhaust air adjacent at least one of the axial faces of each ring in said sleeve for increasing the noise reduction thereof.

2. In a pneumatic tool according to claim 1 said spacing means being axial lugs integral with said rings and provided on one of the axial faces of each ring.

3. In a pneumatic tool according to claim 1 an air inlet passage extending in said housing from the rear end thereof to said motor, a valve mechanism controlling said inlet passage and including a movable valve member adapted to be manually actuated from seated to unseated position when said housing is grasped manually to permit air flow through said inlet passage, said external surface being provided on said housing rearwardly of said air motor therein, and said sleeve having its end opposite to said shoulder directed axially away from said motor to the rear of said housing.

4. In a pneumatic tool according to claim 3 said external surface being provided rearwardly of said valve member around said air inlet passage, a compressed air supply conduit, and separable means at the rear end of said surface and housing for removably connecting said conduit to said housing and passage.

5. In a pneumatic tool as set forth in claim 2 an inwardly extending in the end of said sleeve resting against said shoulder, said sleeve being open to atmosphere at its end opposite to said shoulder, and a resilient locking ring removable fixed to said surface opposite to said shoulder and cooperating with the axially outermost ring for keeping said noise reducing rings stacked between said flange and said locking ring thereby also keeping said flange against said shoulder.

6. In a pneumatic tool a generally cylindrical housing providing a gripping portion centrally thereon, a rotary...
air motor mounted within said housing, an air inlet passage in said housing to said motor, a valve mechanism for controlling said inlet passage and including a movable valve member, lever means cooperating with said valve member for moving it from seated to unseated position when said gripping portion is grasped manually to permit air flow through said inlet passage to said motor, a cylindrical external surface at one end of said housing and having a reduced diameter with respect to said gripping portion, an annular shoulder between said surface and said gripping portion, air exhaust passages longitudinally disposed within said housing connecting the outlet side of said air motor with the end of said external surface adjacent said shoulder, an open ended sleeve extending from said shoulder in substantially parallel spaced relation to said external surface away from said gripping portion, and at least two noise reducing rings of porous sintered material mounted in axially spaced relation between said external surface and said sleeve for reducing the noise of the exhaust air issuing from said exhaust passages to the atmosphere.

7. A noise reducing insert for a pneumatic tool for grouped arrangement in axially stacked disposition one insert adjacent to but axially spaced from the other in an annular exhaust funnel from said tool, said insert comprising an annulus of rectangular cross section consisting of porous sintered material and having angularly spaced axial lugs formed integral therewith for providing the axial spacing between said rings when stacked in said funnel.

8. In a pneumatic tool a generally cylindrical housing, a rotary air motor mounted within said housing, a cylindrical annular exhaust funnel in said housing, air exhaust passages longitudinally disposed within the housing connecting the outlet side of said air motor with one end of said funnel, said funnel having opening means communicating directly with the atmosphere at its end opposite to said exhaust passages, at least two noise reducing rings of porous sintered material mounted in axially stacked relation in and across said funnel for reducing the noise of the exhaust air passing from said exhaust passages through said funnel to the atmosphere, and means in said funnel for keeping said rings axially spaced in said funnel under the formation of a substantially annular expansion chamber for the exhaust air adjacent at least one of the axial faces of each ring in said funnel for increasing the noise reduction therein.

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