June 1, 1965 E. A. KLIEWER, SR 3,186,511

AIR JET EXHAUST MUFFLER

Filed Oct. 26, 1961

2 Sheets-Sheet 1

FIG. 1

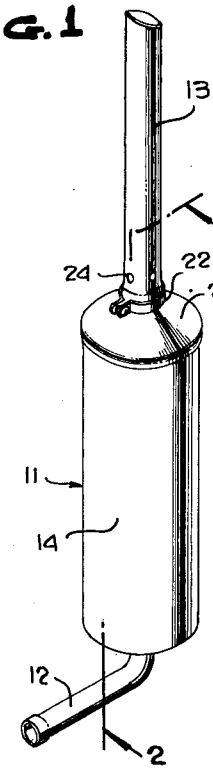


FIG. 11

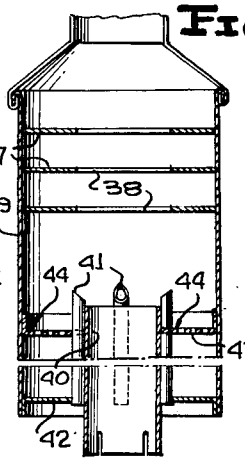


FIG. 2

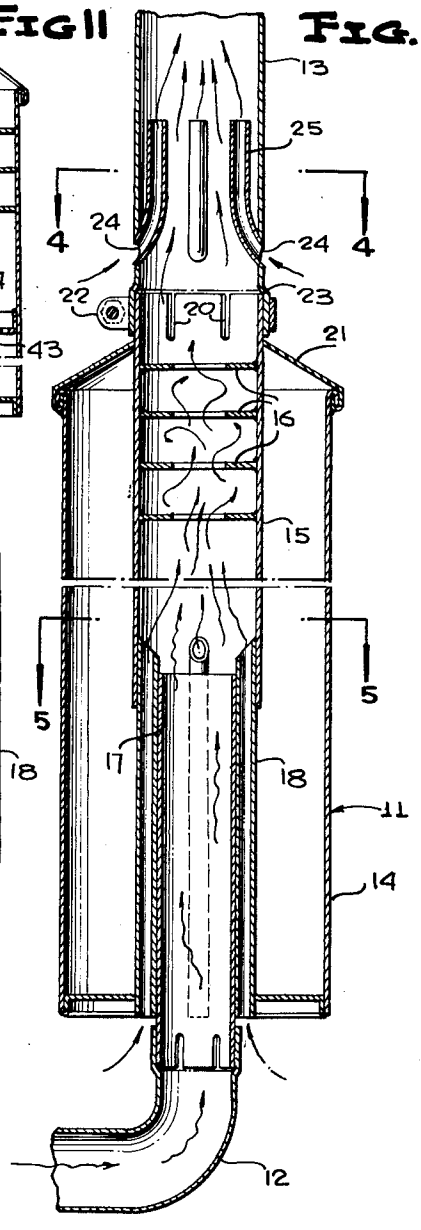


FIG. 3

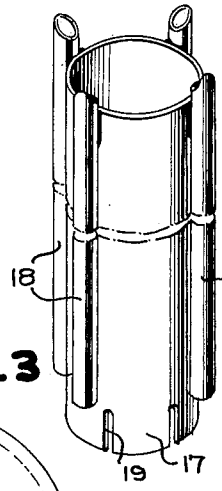
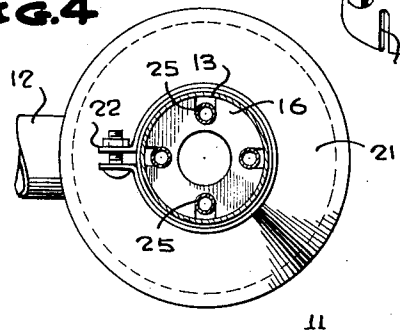


FIG. 4



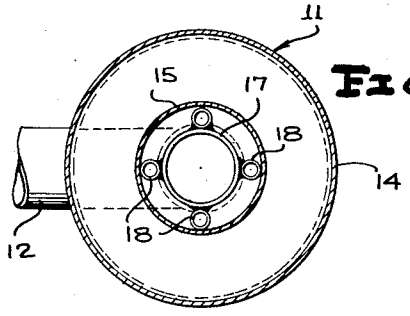


FIG. 5

INVENTOR
EDWARD A. KLIEWER, SR.

BY Mason, Porter, Dickey & Stewart

ATTORNEYS

June 1, 1965 E. A. KLIEWER, SR 3,186,511

AIR JET EXHAUST MUFFLER

Filed Oct. 26, 1961 2 Sheets-Sheet 2

FIG. 6

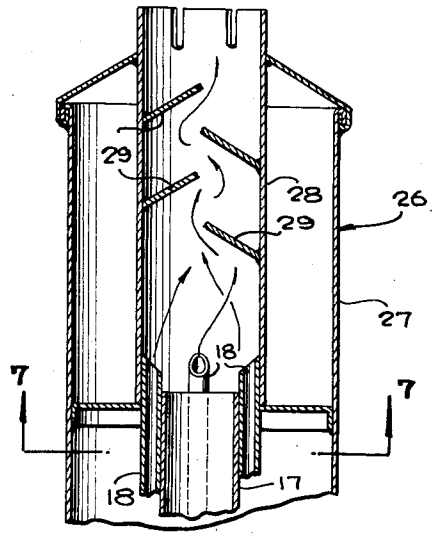


FIG. 7

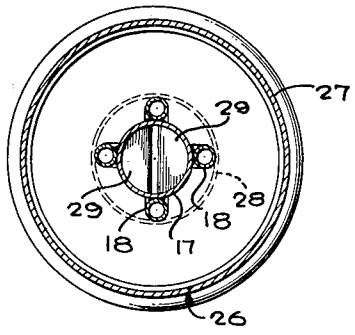


FIG. 9

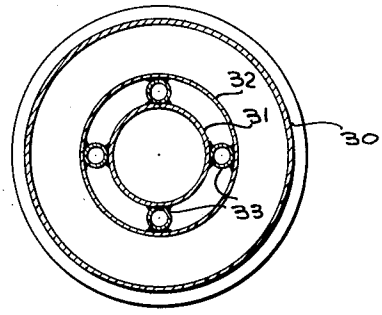


FIG. 8

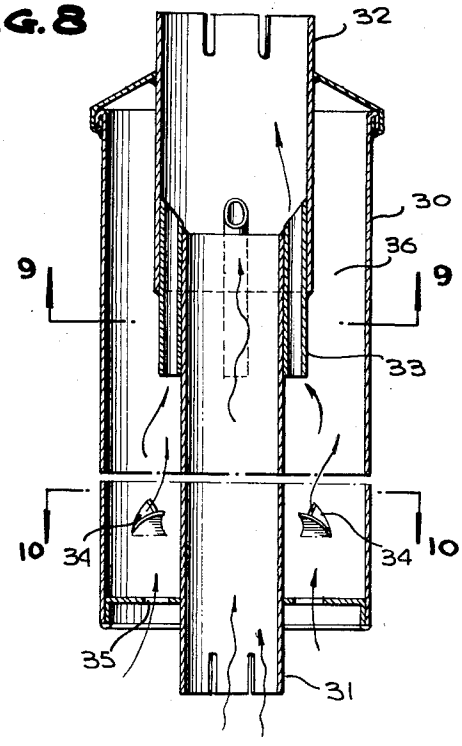
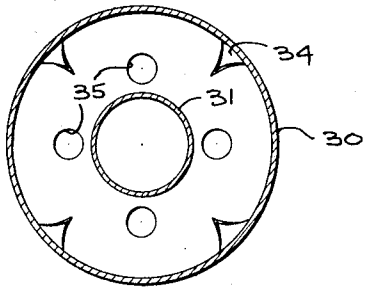


FIG. 10



INVENTOR
EDWARD A. KLIEWER, SR.

BY Mason, Porter, Dillon & Stewart

ATTORNEYS

United States Patent Office

3,186,511
Patented June 1, 1965

3,186,511

AIR JET EXHAUST MUFFLER

Edward Albert Kliewer, Sr., P.O. Box 1282, Longview, Tex.

Filed Oct. 26, 1961, Ser. No. 147,870
10 Claims. (Cl. 181—51)

This invention deals with an improved air jet exhaust muffler for use on trucks, buses and other type motor vehicles or industrial engines, and in particular deals with an improved exhaust muffling system which not only siliences but further eliminates to a great extent smoke emanating from exhaust stacks or the like and reduces the extent to which said exhaust gases will pollute the atmosphere.

The problem of air pollution caused by the exhaust gases of both commercial and pleasure vehicles or industrial engines has in recent years been reaching an alarming level. It is for this reason that much work has been undertaken lately in order to solve the problem. It is known that exhaust systems which introduce fresh air from the surrounding environs into the stream of the burnt combustion gases so as to reduce the smoke and pollutive effect of such exhaust gases have been suggested as a possible solution. Some of these prior systems expose the fresh air inlets to the passing stream of air caused by the motion of the motor vehicle itself and thus utilize this pressure in forcing the fresh air into the stack to so mix and dilute the exhaust gases. Others, to some extent, have even utilized the air jet principle in the drawing or sucking of the fresh air into the exhaust system itself. It is not believed, however, that any of the prior art dilution devices have realized the air jet principle to the extent made possible by the invention disclosed herein or that known devices have successfully diluted the smoke and obnoxious gases present in the combustion products of internal combustion engines so as to render them below a point where they are either annoying or harmful.

It is, therefore, an object of the invention to provide an improved exhaust muffler based upon the air jet principle and which successfully dilutes the exhaust gases of an internal combustion engine and thus renders them harmless when discharged into the atmosphere.

Another object of the invention is to provide an air jet muffler which draws a maximum amount of fresh air into the exhaust stream of an internal combustion engine and further dilutes the stream of exhaust gases at a point distant from the initial dilution.

Another object of the invention is to provide an air jet exhaust muffler which comprises an exhaust tube having fresh air ducts affixed thereto and having their fresh air delivery ends disposed a short distance above the point of delivery of the exhaust gases from the exhaust tube so as to utilize to a maximum extent the air jet principle.

Still another object of the invention is to provide an air jet exhaust muffler wherein is included an exhaust tube having an engine exhaust pipe connected thereto and surrounded by a plurality of fresh air ducts for introducing diluent fresh air into the exhaust gas stream as it emerges from the exhaust tube and further means for introducing additional diluent air into the exhaust gas stream at a point downstream from said first mentioned point of fresh air introduction.

Another object of the invention is to provide an air jet exhaust muffler having primary means for jetting fresh air therein and an exhaust stack extension attached thereto having secondary means by which additional diluent gases are jetted into the exhaust gas stream at a point downstream from the point of initial introduction of fresh air.

Another object of the invention is to provide an air jet exhaust muffler wherein is included a muffler shell having silencing baffles, an exhaust tube delivering into the shell, a plurality of fresh air ducts surrounding the exhaust tube for jetting initial diluent air into an exhaust gas stream passing from the tube into the shell, and an exhaust stack extension connected to the muffler shell and having a plurality of fresh air ducts therein for jetting additional fresh air into the exhaust gas stream at a point downstream from the initial point of diluent air introduction.

Still another object of the invention is to provide an air jet exhaust muffler including an inner or exhaust shell having silencing baffles therein and attached thereto, an exhaust tube disposed to emit exhaust gases into said shell, the exhaust tube being surrounded by a plurality of fresh air ducts which terminate a short distance above the point of delivery of the exhaust gases to the exhaust shell and are provided with inwardly and downwardly cross cut delivery ends.

Still another object of the invention is to provide an air jet exhaust system comprising means for introducing exhaust gases to a muffler body, means for introducing fresh air at a point of low turbulence within the muffler body and disposed slightly above the point at which the exhaust gases are admitted to the muffler body and means for introducing further diluent fresh air at a point downstream from the first mentioned point of entry of fresh air to the muffler body.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a perspective view of the novel air jet exhaust muffler showing its relationship and connection to an additional stack member and to air engine exhaust pipe.

FIGURE 2 is an enlarged longitudinal sectional view taken along the line 2—2 on FIGURE 1.

FIGURE 3 is a perspective view of the exhaust tube and its surrounding fresh air ducts.

FIGURE 4 is a plan view partially in section taken on the line 4—4 on FIGURE 2.

FIGURE 5 is a horizontal sectional view taken on the line 5—5 on FIGURE 2.

FIGURE 6 is a fragmentary longitudinal sectional view of a further embodiment of the present invention and illustrates the use of slanted semi-circular baffles and their relationship to the exhaust tube and its appurtenant air ducts.

FIGURE 7 is a horizontal sectional view taken on the line 7—7 on FIGURE 6.

FIGURE 8 is a longitudinal sectional view of the novel air jet muffler and illustrates a modified means for introducing diluent fresh air to the air jet ducts.

FIGURE 9 is a horizontal sectional view taken on the line 9—9 on FIGURE 8 and illustrating the relationship of the exhaust tube and its surrounding fresh air ducts.

FIGURE 10 is a horizontal sectional view taken on the line 10—10 on FIGURE 8 and shows in particular the modified diluent fresh air entrance means of FIGURE 8.

FIGURE 11 is a fragmentary longitudinal sectional view similar to FIGURE 6 and illustrating an additional modification of baffle and support wall arrangement.

With reference to the drawings and in particular to FIGURE 1, the herein disclosed novel air jet exhaust system is shown in perspective and comprises an air jet exhaust muffler generally designated 11 having an outer shell or casing 14 connected to an engine exhaust pipe 12 and having an additional exhaust stack 13 mounted thereon. The air jet exhaust muffler 11 is comprised of the outer shell 14, an inner shell or casing 15, baffles 16 in the

form of rings or apertured disks located within the inner shell, an exhaust tube 17 and fresh air ducts 18.

The details of the exhaust tube 17, its surrounding fresh air ducts 18 and the relationship of both to the outer shell of the air jet exhaust muffler may be best understood by particular reference to FIGURES 2, 3 and 5 of the drawings wherein it is apparent that the exhaust tube 17 is disposed within the outer shell 11 at its lower portion. The exhaust tube 17 has connected thereto a plurality of fresh air ducts 18 the number of which is dependent on the particular exhaust application and has been found preferably to be four to six in number for most applications. The fresh air ducts 18 may be attached to the exhaust tube 17 in any approved manner, as by spot-welding, brazing or like connection methods. It should be noted that the upper end extremities of the fresh air ducts 18 are tapered or cut across inwardly and downwardly toward the central axis of the exhaust tube 17 as shown in FIGURES 2 and 3, and said upper end extremities preferably are disposed a short distance above the upper terminal of the exhaust tube 17.

As the exhaust gases are forced through the exhaust pipe 12 from an internal combustion engine, they are directed into the exhaust tube 17 from which they are emitted to the atmosphere through the exhaust muffler itself. The upward flow of the exhaust gases as they are admitted into the exhaust muffler creates a strong force which draws fresh diluent air from the atmosphere into the gaseous stream through the fresh air conduits 18. By placing the upper fresh air introducing outlets of the ducts 18 slightly above the exhaust tube 17 and shaping them in the manner shown, a maximum air jetting effect will be obtained. The lower entrant or inlet ends of the fresh air ducts 18 can be provided, if desired, with air scoops or funnels or other air directing means so as to facilitate the introduction of fresh air into the exhaust gas muffling and diluting system.

The exhaust tube 17 is provided at its lower end with a plurality of upwardly extending slots 19, and the upper terminal portion of the inner shell 15 with like slots 20. The provision of such slots 19 and 20 facilitates the attachment of the exhaust pipe 12 and additional stack 13 in the manner illustrated in FIGURE 2.

The upper portion of the outer shell 14 is provided with a conical top 21 above which the extension stack 13 is attached to the inner shell 15 by clamp means 22. The details of the additional stack 13 are best shown in FIGURES 2 and 4, and it will be observed that the flanged lower portion 23 provides easy connection with the upper portion of the inner shell 15, and that air inlet holes are provided at 24. Further air ducts 25 are affixed within the added stack 13 in position to receive air from the exterior through their air inlet holes 24 or lower ends and deliver it through their upper ends, as viewed in FIGURE 2, into said stack 13.

The initially diluted gases pass from the main air jet zone at the lower end, as viewed in FIGURE 2, upward through the top portion of the inner or exhaust shell 15, being silenced on the way by the baffles 16 into and through the additional stack 13 and eventually to atmosphere. The exhaust gases as they rush past the fresh air tubes 25 create an air drawing force similar to that described in connection with the ducts 18 by which further fresh air is drawn into the exhaust system. It should be understood that the generally circular baffles 16 preferably are provided with holes of diameter larger than that of the engine exhaust.

It will be understood from the preceding disclosure of preferred embodiment of FIGURES 2 through 5 that the exhaust gases passing from the engine are first directed upwardly through the exhaust tube 17 from which they are discharged into the lower end of the inner shell 15 where, through action of the air jet principle, diluent fresh air will be drawn in through ducts 18. The thus initially diluted exhaust gases then pass upwardly through the

baffles 16 and into the additional stack 13 wherein the already diluted gases are further diluted with additional fresh air through the action of the secondary air jet ducts 25 acting to draw atmospheric air through holes 24 and delivering the same into the stack 13. The toxicity and the relative amount of carbon present in the exhaust gases as they are emitted to the atmosphere are so substantially reduced through the use of the herein disclosed air jetting means that the finally emitted exhaust gases may no longer be considered objectionably noxious.

A further modification of the present invention is shown in FIGURE 6 depicting a muffler generally designated 26 and having an outer shell or casing 27 and an inner shell 28. The inner shell 28 is provided with two or more generally semi-circular baffles 29 which are attached to the inner surface of the shell 28, as by welding or the like, and are preferably mounted therein at an angle of approximately 30 degrees to the direction of flow of the exhaust gases.

In this modification, as well as in the embodiment presented in FIGURES 2 through 5, the exhaust tube 17 and its surrounding fresh air ducts 18 are constructed and arranged in generally the same manner. The exhaust tube 17 and the fresh air ducts 18 are also disposed centrally of the outer shell 27, and said ducts 18 may be conveniently attached to the inner shell 28 and to said tube, as by welding or the like.

Another embodiment of the present invention, and in particular a modified fresh air introducing means, is shown in FIGURES 8 through 10. Referring to the drawings and in particular to FIGURE 8, an outer muffler shell or casing 30 is provided and has an exhaust tube 31 and an inner shell 32, respectively, disposed in the lower and upper sections thereof. Fresh air ducts are attached to the exhaust tube 31 and, in turn, to the inner shell 32 by any acceptable means, such as spot-welding or brazing. The lower portion of the shell 30 is provided with air inlet means 34 which may be in the form of punched or cut wall portions in the shell itself, and further with bottom holes 35 which, coupled with inlets 34, provide for the introduction of diluent fresh air. As the exhaust gases pass upwardly through the exhaust tube 31 and are emitted into the shell 32 and past the upper discharge ends of the tube 33, a suction or partial vacuum is creased which results in an indrawing of air upwardly through the tubes 33. The inlet tubes 33 do not directly open to atmosphere externally of the muffler structure but are foreshortened as compared to the previous modifications, and terminate downwardly in chamber 36 of the outer shell member 30. The fresh air within outer shell 30, being constantly replenished by reason of the communication to the atmosphere through the struck out inlets 34 and holes 35, supplies the source of fresh air which is drawn upwardly through tubes 33 and into the main flow of the gaseous exhaust.

In FIGURE 11, there is shown another modification of the invention wherein the previously described inner shell 15 is omitted and the perforated disk or ring baffles 37 having the central openings 38 which are larger than the diameter of the engine exhaust are directly supported on the shell or casing 39 downstream of the outlets from the exhaust tube 40 and the air jet tubes 41. While ring or perforated disk baffles are shown in FIGURE 11, it is to be understood that baffles of the character shown in FIGURE 6 may be employed, if desired. In this form the end of the casing 39 is closed at 42 and the exhaust tube 40 and air jet tubes are supported by a cross wall 43 mounted intermediately of the ends of the casing and attached to the casing wall in any approved manner, as by welding. The cross wall 43 is apertured at 44 to allow the turbulence at the point of exhaust to have some release through the perforations into the closed chamber between this baffle wall and the closed casing end shown at the bottom in FIGURE 11. It is to be understood that the exhaust delivery end of the casing in

this form may or may not be equipped with the stack and second set of air jet tubes as shown in FIGURE 2, according to desire in the particular installation.

In all of the forms of invention described herein, it will be observed that the fresh air ducts are disposed slightly above the upper terminal of the exhaust tube and that the terminal ends of the air ducts are tapered or angularly cross cut downwardly and inwardly toward the central axis of the exhaust tube. By this provision, it has been found that a maximum of air jetting effect can be obtained, that is, the exhaust gases as they pass upwardly into the exhaust stack will at a point slightly above the upper terminal of the exhaust tube produce their greatest air drawing effect and thereby will cause the greatest amount of fresh air diluent to be drawn into the exhaust system in the shortest possible time. The disposition of the air ducts, as well as the provision of said tapered or angle cut edges has been found to substantially diminish the turbulence normally found in areas of air mixture. The exhaust gases as they pass upwardly into the exhaust stack will be located in a somewhat central columnar effect and thus create a drawing force mainly at the column circumference, thus to draw the fresh air diluent upwardly along the sides of the exhaust tube and produce substantially laminar rather than a turbulent mixed gas flow.

While preferred and modified forms of exhaust muffling and diluting structures are disclosed in detail herein, it is to be understood that variations in part structure and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a muffler structure, a shell, an exhaust tube comprising an imperforate hollow tube having an open exhaust delivery end within said shell and an open exhaust receiving end, said shell having an exhaust delivery end distal from the exhaust delivery end of said exhaust tube and surrounding and being spaced from the delivery end of said exhaust tube, a plurality of air jet tubes fixed adjacent to and disposed along the exterior of said exhaust tube, said air jet tubes comprising imperforate hollow tubes having air receiving open ends in communication with the atmosphere and having air delivery open ends extending slightly beyond said exhaust delivery end of said exhaust tube, said shell defining a substantially continuous gas flow path in the direction of the axis of the exhaust tube downstream of the delivery ends of said air jet tubes whereby a flow of exhaust gases from said exhaust delivery end of said exhaust tube draws atmospheric air through said air jet tubes.

2. A muffler structure as defined in claim **1**, wherein said shell is provided at its exhaust delivery end with an exhaust stack, and air jet means in said exhaust stack in communication with the atmosphere for introducing additional atmospheric air into the exhaust stream.

3. In a muffler structure as defined in claim **1**, an exhaust stack on said shell at the exhaust delivery end thereof, air tubes within said exhaust stack, said air tubes having air receiving ends in communication with the atmosphere and air delivery ends within said exhaust stack.

4. In a muffler structure as defined in claim **1**, baffle means disposed directly between said exhaust delivery end of said exhaust tube and said exhaust delivery end of said shell.

5. A muffler structure as defined in claim **1**, wherein said shell has a wall closing the same about the exhaust tube adjacent to the exhaust receiving end of said exhaust tube, and an intermediate wall supporting the exhaust delivery end of said exhaust tube and said air jet tubes, said intermediate wall being spaced from the first mentioned wall to provide an expansion chamber therebetween and having apertures therein to permit turbulent gases delivered from the exhaust tube to enter and expand in the expanison chamber.

6. A muffler structure as defined in claim **1**, wherein the exhaust receiving end of said exhaust tube extends beyond the air receiving ends of said air jet tubes, and the air delivery ends of said air jet tubes are angularly cut off inwardly and downwardly toward the central portion of the exhaust tube.

7. In a muffler structure, an outer casing, an exhaust tube having an exhaust delivery end within the casing and an exhaust receiving end, said outer casing having an exhaust delivery end distal from the exhaust delivery end of said exhaust tube and surrounding and being spaced from the delivery end of said exhaust tube, a plurality of air jet tubes fixed adjacent to and disposed along the exterior of said exhaust tube, said air jet tubes having air receiving ends in communication with the atmosphere and having air delivery ends extending slightly beyond said exhaust delivery end of said exhaust tube, whereby a flow of exhaust gases from said exhaust delivery tube draws atmospheric air through said air jet tubes, an inner shell having an exhaust delivery end projecting from said exhaust delivery end of said outer casing and having an exhaust receiving end overlying said air jet tubes and spaced thereby from said exhaust tube.

8. In a muffler structure as defined in claim **7**, and circular baffles having a central opening therein disposed within said inner shell.

9. In a muffler structure as defined in claim **7**, and semi-circular silencing baffles disposed in overlapping relationship to each other within said inner shell.

10. A muffler structure as defined in claim **7**, wherein said air jet tube receiving ends are disposed within the outer casing, said casing including a base and sides, and holes formed in said base and sides for providing access of atmospheric air to said air jet tube receiving ends.

References Cited by the Examiner

UNITED STATES PATENTS

1,864,915	6/32	Kosterman	181—51
1,877,523	9/32	Gordon	60—30 X
1,966,620	7/34	Fluor	181—51
2,829,730	4/58	Barkelew	181—51 X
2,829,731	4/58	Clayton	60—30
2,862,570	12/58	Jacobs et al.	181—50

FOREIGN PATENTS

552,142	1/23	France.
314,290	1/34	Italy.

LEO SMILOW, *Primary Examiner.*

ALDRICH F. MEDBERY, *Examiner.*