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AIR JET PUMP

Filed May 9, 1967 Sheet 1 of 2

FIG. 1

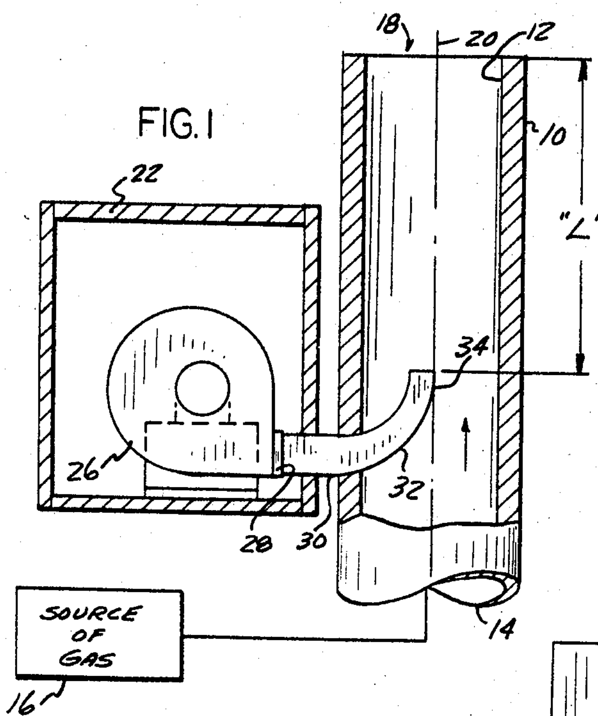

FIG. 5

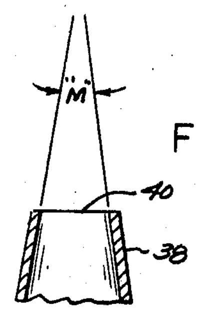

FIG. 2

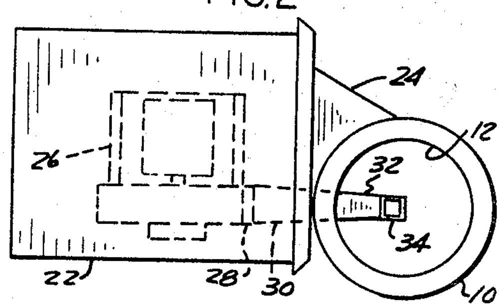

FIG. 4

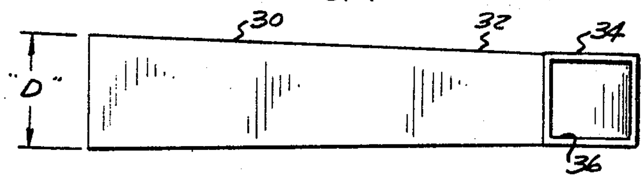

FIG. 3

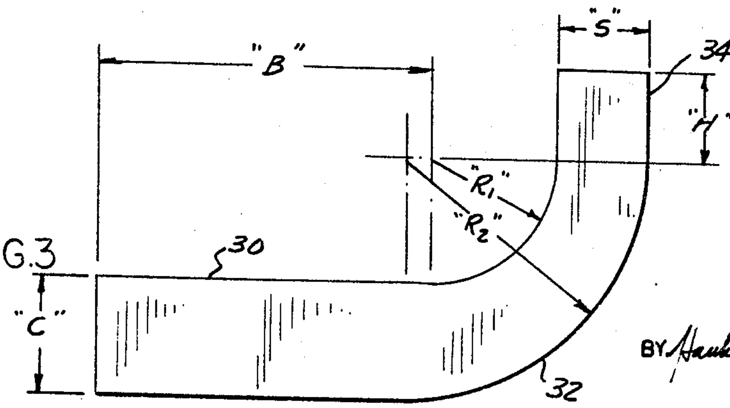

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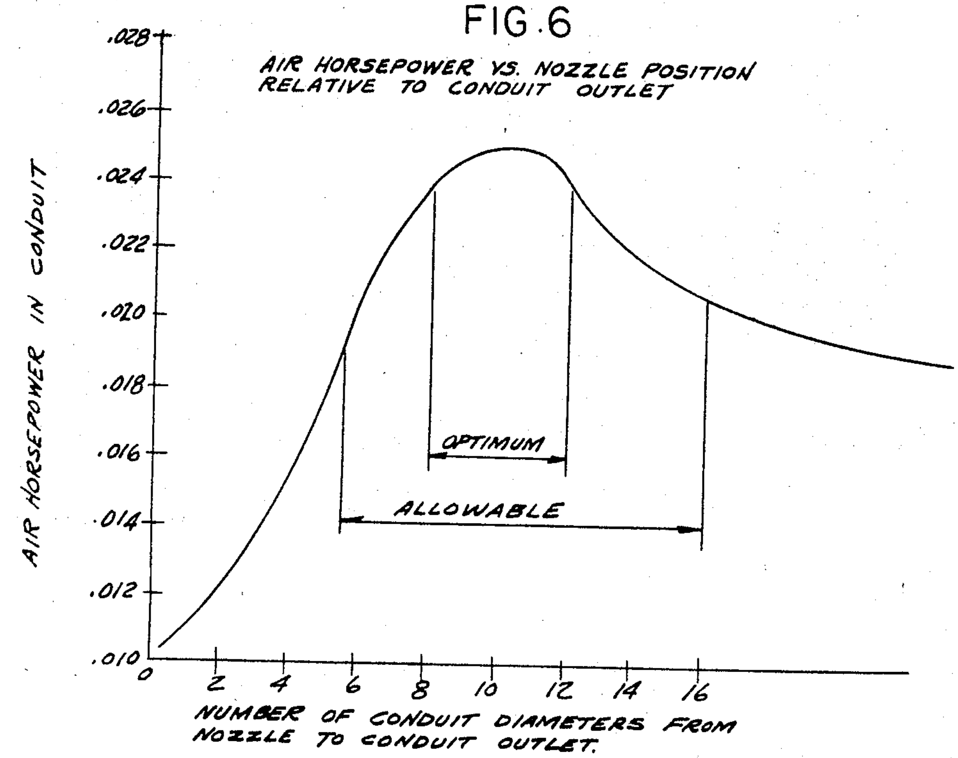
FIG. 6



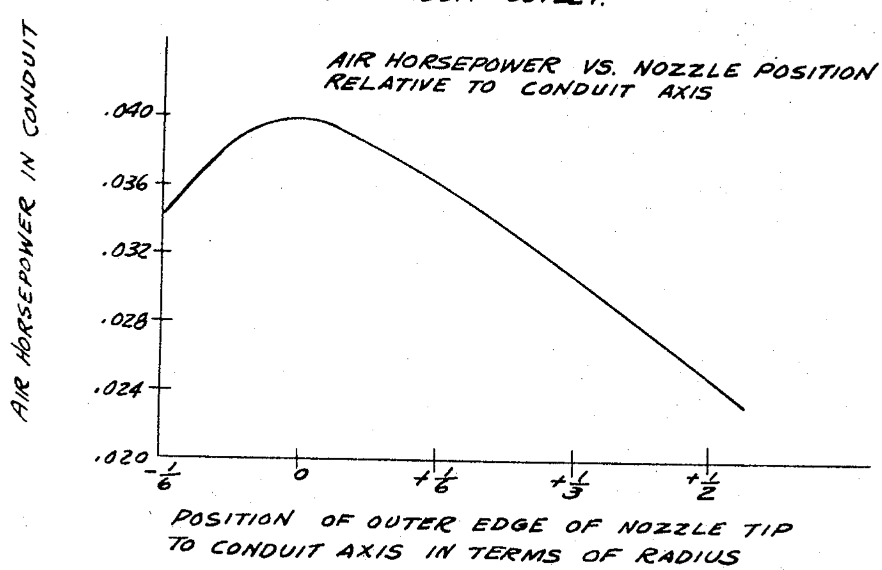


FIG. 7

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AIR JET PUMP

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ABSTRACT OF THE DISCLOSURE

An air ejector mounted within and near the outlet of a chimney to create an artifical draft of the chimney gases. A rectangular or square nozzle supported a predetermined distance from the outlet and offset from the axis of the chimney discharges pressurized air toward the outlet to induce a positive gas flow.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to ejector systems for fume removal and more specifically to an air ejector apparatus having an offset discharge nozzle supported a predetermined distance from the outlet of a chimney conduit having a uniform transverse cross section and which discharges compressed air toward the chimney outlet to create an artificial gas flow.

Description of the prior art

Air ejector systems are commonly employed to provide an artificial draft in the chimney of commercial and industrial incinerators, boiler units, and those applications where it is necessary to transfer gases from a source such as a combustion unit to a discharge area through a conduit. Systems of this type are also employed as a material handling means wherein a fluid such as a gas is to be transferred from a first area to a second area. Air ejector pumping systems have a special advantage in that the materials contained in the transferring gas do not impinge upon or corrode the air pump components.

It is common practice to mount the air nozzle on the axis of the conduit so that the pressurized air is discharged axially toward a venturi-like throat in the conduit. This symmetrical arrangement has a number of drawbacks, particularly where it is necessary to incorporate a draft producing air jet pump in a conventional chimney having a uniform transverse cross section from the nozzle outlet to the chimney outlet. This is due to the expense of installing the venturi throat downstream from the nozzle.

The broad purpose of the present invention is to provide an efficient air jet pump which may be incorporated within a chimney or similar conduit having a uniform cross section in the direction of its length without the necessity for the venturi throat and which has improved draft-inducing efficiencies.

SUMMARY

The preferred embodiment of the invention is described with reference to a chimney conduit having a circular cross section, however it is to be understood that it is equally applicable to a square or other conventional cross section which is generally constant for a predetermined length adjacent the outlet end of the stack. The preferred system includes a duct extending laterally through the chimney wall and toward the axis of the chimney conduit. The duct inlet is connected to a source of pressurized air and preferably a centrifugal fan type

compressor. An elbow within the conduit has one end connected to the duct and its opposite end terminating in a nozzle having a rectangular cross section. The discharge end of the nozzle is directed toward the outlet of the conduit. The rectangular cross section of the nozzle improves the entrainment of the gases flowing through the conduit because of the greater surface area of the air jet discharged from the nozzle for a given cross sectional area as opposed to a circular discharge area.

The nozzle is supported with its outer side wall tangential to the axis of the conduit so that the discharge opening of the nozzle is laterally offset from the axis of the conduit. Preferably the discharge nozzle is supported upstream from the conduit outlet a distance lying in a range between 5.5 and 16 times the diameter of the conduit. This range permits flexibility in mounting the nozzle in a conventional stack and still insures satisfactory performance. Performance tests indicate that an optimum efficiency results when the discharge end of the nozzle is positioned ten times the diameter of the exhaust end of the conduit from the conduit outlet.

Preferably the duct from the discharge of the air fan to the nozzle curves in a common lateral direction from the fan to the nozzle as distinguished from an S curve flow path. In addition performance tests have indicated that improved results are obtainable by making the side walls of the nozzle convergent toward the discharge opening within an angle of convergency of 0 to 14 degrees. However, satisfactory results can also be obtained by a non-convergent nozzle.

The preferred air jet pump nozzle arrangement has a number of definite advantages over air jet pumps of the prior art including its easy adaptability to existing or new, round or square, brick masonry or metal conduits; the ease in mounting the fan on the conduit; and the elimination for the requirement for a venturi throat in the conduit to provide a satisfactory draft.

It is therefore an object of the present invention to provide in combination with a conduit having an inlet connected to a source of a gas and an outlet for the discharge of the gas, air ejector apparatus for inducing a draft of the gas from the inlet and toward the outlet through an exhaust section formed symmetrically about an axis and terminating with the outlet of the conduit and including a nozzle having a discharge opening and supported in the exhaust section upstream of the outlet with the discharge opening directed toward the outlet and the periphery of the discharge opening being contiguous with the axis of the conduit, a source of pressurized air and duct means connecting the pressurized air to the nozzle.

It is another object of the present invention to provide in combination with a conduit having an inlet connected to a source of gas, an outlet for the discharge of the gas and an exhaust section formed symmetrically about an axis and terminating with the outlet, air ejector apparatus for inducing a draft for the gas from the source and towards the outlet comprising a nozzle having a discharge opening supported within the exhaust section upstream from the outlet and laterally offset from the axis of the exhaust section, the nozzle having a rectangular cross section with the discharge section opening directed toward the conduit outlet, a source of pressurized air, and duct means connecting the source of pressurized air to the nozzle.

It is a still further object of the present invention to provide means for creating an artificial draft in a conduit for exhausting a gas through the conduit and toward a conduit outlet by providing a rectangular nozzle connected to a source of pressurized air and having a discharge opening supported within the condiut and directed toward the conduit outlet, and being positioned upstream from the conduit outlet a distance between 5.5 and 16 times the diameter of the conduit.

Still other objects and advantages of the present invention will readily occur to one skilled in the art to which the invention pertains upon reference to the detailed description.

Description of the drawings

The description refers to the accompanying drawings in which like reference characters refer to like parts throughout the several views and in which:

FIGURE 1 is an elevational sectional view of an air pump apparatus mounted to a conduit with a duct and nozzle illustrating the preferred embodiment of the invention and with parts in section for purposes of clarity;

FIGURE 2 is a plan view of the air ejector apparatus and conduit of FIGURE 1;

FIGURE 3 is an elevational view of the preferred duct and nozzle separated from the other components of the system;

FIGURE 4 is a plan view of the duct and nozzle of FIGURE 3;

FIGURE 5 is a fragmentary sectional view illustrating a convergent nozzle showing an alternative embodiment of the invention;

FIGURE 6 is a graphical illustration showing the performance associated with various nozzle positions relative to the conduit outlet; and

FIGURE 7 is a graphical illustration showing the performance associated with various nozzle positions laterally displaced with respect to the conduit axis.

Description of the preferred embodiment

Now referring to the drawings, number **10** refers to a chimney or similar casing having a conduit **12** having a uniform circular cross section throughout its length. The lower end of the conduit **12** is connected to a source of gas **16** which is discharged through an outlet **18** at the upper end of thet conduit **12**. Although the chimney **10** defines a conduit having a circular cross section it is to be understood that the chimney could as well define a square conduit or other conventional shape which is symmetrical about a longitudinal axis **20**.

A housing **22** mounted on the chimney **10** by bracket **24** supports a centrifugal air pump **26**. The air pump **26** provides means for supplying a source of pressurized air through a fan discharge opening **28** to a straight section of duct **30** having a rectangular cross section. The duct **30** extends through the wall of the chimney **10** in a lateral direction to the axis **20** and merges with an elbow section **32** which directs the pressurized air upwardly through a nozzle section **34**. As best seen in FIGURES 3 and 4, the nozzle **34** has a rectangular or preferably square discharge opening **36**. In addition, the duct **30** and the elbow section **32** are preferably gradually and regularly narrowed from the inlet of the duct **30** and toward the nozzle section **34**.

It has been found from performance tests that the improved air pump ducting has a close interrelationship between its various components which contribute toward an overall optimal performance. Thus the length of the straight section **30** as indicated by the letter B is preferably one and half times the thickness of the wall of the chimney **10** and in no case is it less than one inch. The duct section **30** has a rectangular inlet defined by a height C and a width D. The radius of the inner side wall of the elbow section **32** and indicated at R1 is preferably equal to C. R2 which defines the radius of curvature of the outer side wall of the elbow **32** is preferably equal to two times the dimension C. It is to be understood that the forementioned dimensions define the flow path of the air and consider the ducting as being formed of a sheet metal having a relatively nominal thickness.

The nozzle **34** preferably has a length extending in the direction of the flow path of the air and indiacted by H which corresponds to the diameter S of the nozzle discharge opening **36**. Referring back to FIGURE 1, the discharge opening **36** is directed toward the outlet **18** with the outer wall of the nozzle **34** which forms an extension of the outer curved wall of the elbow **32** supported so that it is tangential to the conduit axis **20**.

The discharge end **36** of the nozzle **34** is preferably positioned with respect to the outlet **18** a distance indicated at L which ranges between 5.5 and 16 times the diameter of the conduit **12**. For best results, L is 10 times the diameter of the exhaust portion of the conduit **12**.

The embodiment of FIGURE 1 illustrates a nozzle section **34** having side walls parallel to the longitudinal axis of the nozzle, however, as can best be seen in FIGURE 5, an alternative form of nozzle **38** has side walls converging toward a discharge opening **40** at an included angle M. Preferably M lies in a range of 0–14 degrees.

FIGURE 6 illustrates the results achieved by positioning the nozzle **34** at various distances from the outlet **18** of the conduit. Thus it can be seen that in terms of the air horsepower achieved in the conduit for a given air jet, the optimum distance is approximately 8 to 12 times the diameter of the conduit with satisfactory results obtainable between 5.5 to 16 times the diameter of the conduit.

Similarly FIGURE 7 is a graphical illustration showing the improved results obtained by positioning the nozzle at a position laterally offset from the axis of the conduit **12**. Thus the best performance is achieved when the outer edge of the nozzle **34** is arranged along the axis of the conduit **12**.

It can therefore be seen that an improved air jet pump arrangement for creating an artificial draft through a conduit for exhausting the gas has been described which provides an efficient performance without the requirement of the conventional venturi-like throat. By employing a rectangular or square nozzle and arranging the edge of the nozzle contiguous with the conduit axis and a predetermined distance from the conduit outlet, a highly efficient draft-producing arrangement is available for conventional ducts. Furthermore the preferred apparatus can be readily mounted to conventional chimneys to provide an artificial draft. By providing a suitable damper and a sensor associated with the source of the gas, the discharge magnitude of the draft can be readily controlled.

Although we have described the invention in its simplest terms, it is to be understood that various changes and revisions can be made therein without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. In a conduit having a constant cross-sectional area throughout its length, an inlet connected to a source of gas, an outlet for the discharge of said gas, and an exhaust section formed symmetrically about an axis and terminating with said outlet, an air pump apparatus for producing a draft of the gas from said source to said outlet, comprising:

(a) a nozzle having a discharge opening and supported within said exhaust section upstream from said outlet with said discharge opening laterally offset from said axis, said nozzle having a rectangular cross section with the discharge opening directed toward said conduit outlet,

(b) a source of pressurized air, and

(c) duct means connecting said source of pressurized air and said nozzle,

(d) the discharge opening of said nozzle being disposed upstream from the outlet of said conduit a distance comprised between 8 and 12 times the diameter of said exhaust section.

2. The combination as defined in claim **1**, wherein said nozzle has side walls converging in the direction of the flow path of the pressurized air towards said discharge opening at an included angle comprised between 0 and 14 degrees.

3. The combination as defined in claim **1**, wherein said nozzle has side walls converging in the direction of the flow path of the pressurized air towards said discharge opening at an included angle comprised between 0 and 14 degrees.

4. The combination as defined in claim **2**, wherein said nozzle has an edge located in said conduit substantially at the axis of said conduit.

5. The combination as defined in claim **3**, wherein said nozzle has an edge located in said conduit substantially at the axis of said conduit.

6. The combination as defined in claim **1**, wherein said duct means between said source of pressurized air and said nozzle approach the axis of said conduit from a lateral direction, and all directional changes in the flow path of the air from said source to said nozzle are in a common lateral direction.

7. The combination as defined in claim **6**, wherein said duct means has an axis substantially normal to the axis of said conduit, said duct means having a rectangular cross section of a width defined in the direction of the axis of said conduit and an elbow connecting said duct means and said nozzle, said elbow having an inner side formed on a radius corresponding to said width and an outer side formed on a radius corresponding to twice said width, and said nozzle having a length in the direction of said nozzle axis corresponding to the diameter of said nozzle discharge opening.

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