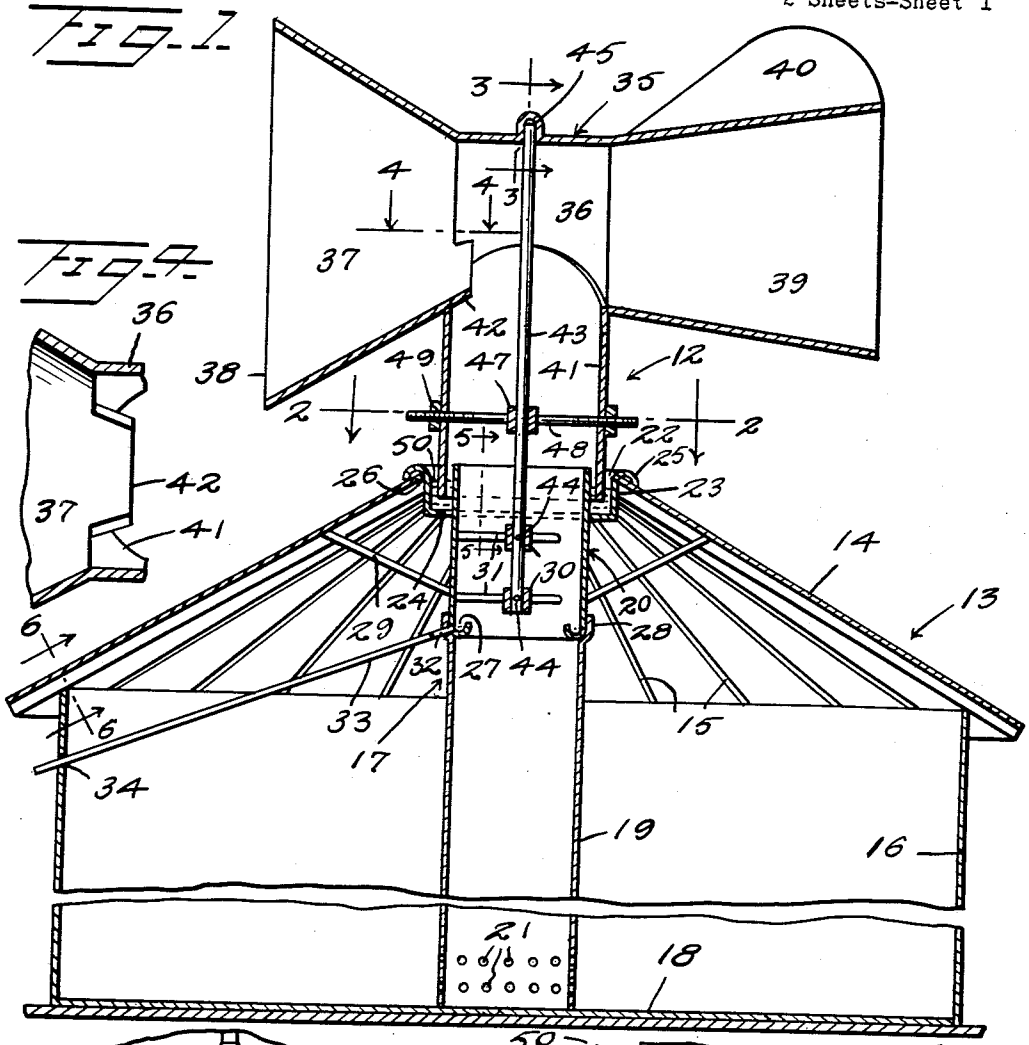
Oct. 18, 1955 W. A. NOEL 2,720,825

JET-TYPE ENCLOSURE VENTILATOR

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FIG. 1



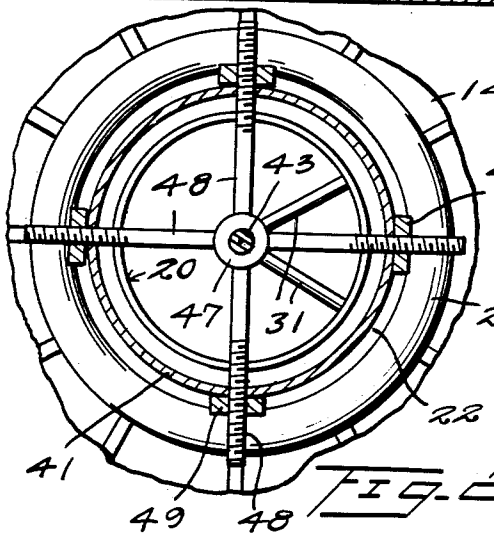


FIG. 2.

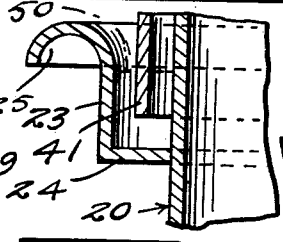


FIG. 5.

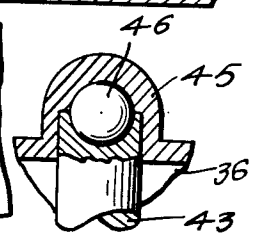


FIG. 3.

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Oct. 18, 1955 W. A. NOEL 2,720,825

JET-TYPE ENCLOSURE VENTILATOR

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FIG. 6.

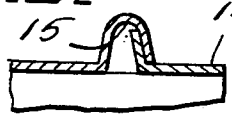


FIG. 7.

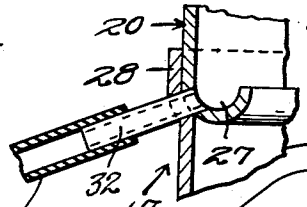
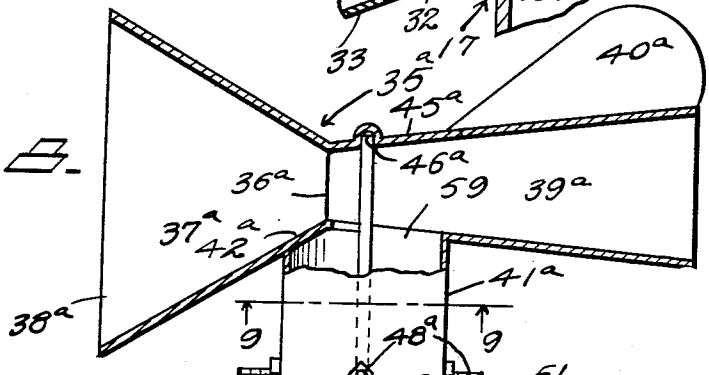


FIG. 8.



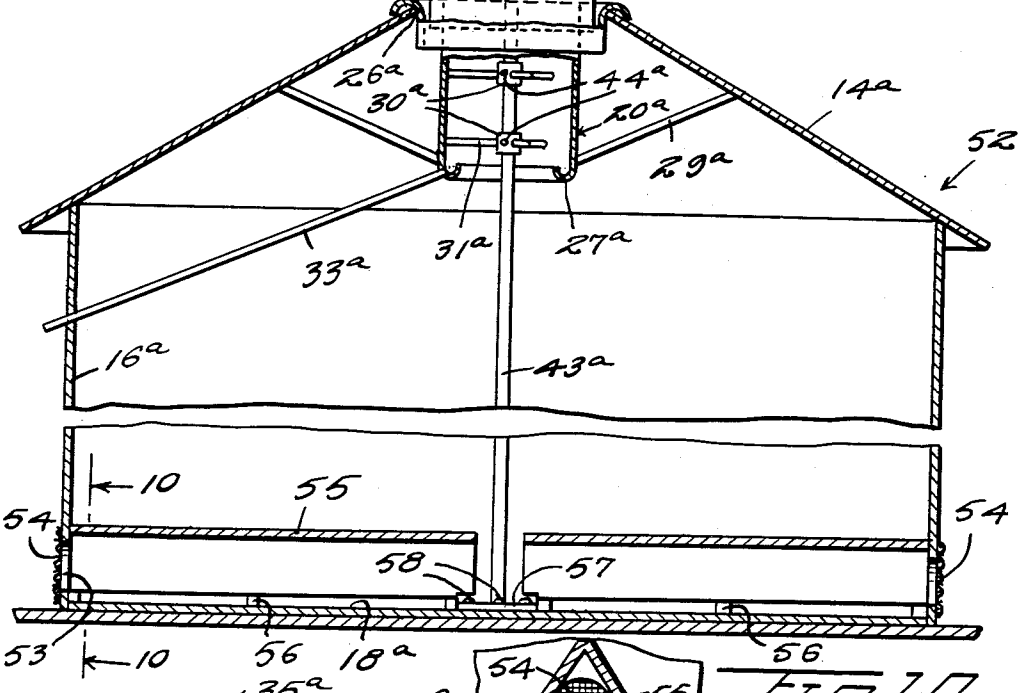


FIG. 9.

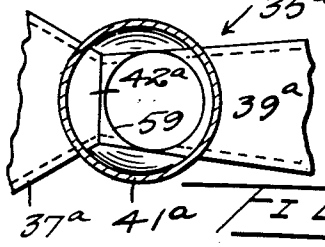
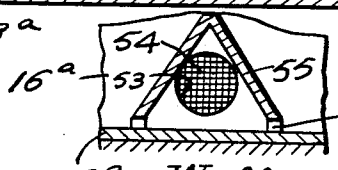


FIG. 10.



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2,720,825

JET-TYPE ENCLOSURE VENTILATOR

William A. Noel, McLean, Va., assignor of one-half to Harry E. Pontius, Rockville, Md.

Application November 5, 1952, Serial No. 318,848

2 Claims. (Cl. 98—55)

This invention relates to a novel ventilator for enclosures which is primarily adapted for ventilating grain bins but which may obviously be used for ventilating other enclosures through which a circulation of air is desirable to reduce moisture and to cool the enclosure.

More particularly, it is an aim of the present invention to provide a ventilating unit including a substantially upright stack extending from within an enclosure upwardly through the top or roof thereof and which communicates at its upper end with a venturi or jet-type tube which communicates with the upper end of the stack at a point spaced from the ends of the tube and which is disposed at an angle to the axis of the tube and with the axis thereof in substantially a horizontal plane, so that air will pass longitudinally through the tube entering a flared entrance end thereof, which is held facing into the wind by a vane, for creating a suction in the stack to suck air upwardly from the enclosure through the stack and into the tube.

More particularly, it is an object of the present invention to provide an apparatus of the aforedescribed character having means to seal an upper rotatable section of the stack from a lower stationary section thereof for maintaining the suction in the lower stationary section of the stack to prevent air entering at the joint of the stack sections.

Another object of the invention is to provide a novel construction of jet tube wherein the air is not only compressed in passing from the mouth of the tube to the throat thereof for increasing the velocity of the air and the suction created in the stack which communicates with the tube throat but wherein means is provided for deflecting the air passing through the jet tube away from the upper end of the stack to thereby further increase the suction within the stack.

Another object of the invention is to provide a ventilator system having drainage means for carrying off condensation which may occur in the upper portion of the stack and jet tube to prevent such condensation from passing downwardly through the stack into the enclosure.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, illustrating the presently preferred embodiments thereof, and wherein:

Figure 1 is a substantially central vertical sectional view, partly broken away, showing one form of the ventilator for use with one type of grain storage bin;

Figure 2 is an enlarged horizontal sectional view thereof taken substantially along a plane as indicated by the line 2—2 of Figure 1;

Figure 3 is an enlarged fragmentary vertical sectional view taken substantially along a plane as indicated by the line 3—3 of Figure 1;

Figure 4 is an enlarged fragmentary horizontal sectional view taken substantially along a plane as indicated by the line 4—4 of Figure 1;

Figure 5 is an enlarged vertical sectional view taken substantially along a plane as indicated by the line 5—5 of Figure 1 and showing a portion of the ventilator as it would appear detached from the grain bin;

Figure 6 is an enlarged fragmentary vertical sectional view taken substantially along a plane as indicated by the line 6—6 of Figure 1;

Figure 7 is an enlarged fragmentary view partly in section and partly in elevation illustrating in detail a portion of the structure shown in Figure 1;

Figure 8 is a substantially central vertical sectional view, partly in side elevation, of a slightly different form of the ventilator shown in conjunction with a different type of grain storage bin;

Figure 9 is a horizontal sectional view of a portion thereof taken substantially along a plane as indicated by the line 9—9 of Figure 8, and

Figure 10 is a vertical sectional view taken substantially along a plane as indicated by the line 10—10 of Figure 8.

Referring more specifically to the drawings, and first with reference to the form of the ventilator unit, designated generally 12 and illustrated in Figures 1 to 7, the ventilator unit is illustrated in conjunction with a conventional type of grain bin, designated generally 13. However, as the description proceeds it will become apparent that the ventilator 12 is equally well adapted for use with other types of enclosures where maintenance of a forced ventilation is desirable for cooling the enclosure and for reducing the moisture content of whatever may be stored therein. The bin or enclosure 13 as illustrated may be assumed to be formed of metal having a corrugated roof 14 forming grooves 15 in the underside thereof so that the portion of the underside of the roof which rests on the bin wall 16 will provide vent openings where the grooves 15 extend across the upper edge of the wall 16. The bin or enclosure 13 merely illustrates one type of enclosure which is not sealed and so that air may enter the enclosure. Other types of enclosures which are not airtight, such as wooden enclosures are equally adaptable to be ventilated by the unit 12. Furthermore, the bin or enclosure 13 may be of any desired size and shape and for the purpose of clarity the ventilating unit 12 as illustrated, is shown substantially larger than would ordinarily be employed with an enclosure 13 of the width or diameter as illustrated; however, the relative size of the unit 12 and an enclosure with which it is employed may vary, as will hereinafter become apparent.

The ventilating unit 12 includes a lower substantially upright tubular stack 17 the lower end of which preferably rests on the enclosure floor 18. The stack 17 may be formed of a lower section 19 and an upper section 20, as illustrated, for ease in assembly in enclosures of different types. The lower section 19, the lower end of which rests on the floor 18, is provided adjacent its lower end with a series of openings or perforations 21 through which air enters the stack from the enclosure space surrounding the stack. The upper stack section 20 is provided with an upwardly opening channel 22 disposed around the upper end thereof and formed by the upper portion of said stack section and by an annular wall 23 which is disposed concentrically therearound and spaced therefrom and which has an inturned flange 24 at its lower end which is disposed tightly around and secured to the stack section 20 in any suitable manner to form a liquid-tight connection therewith. The upper end of the wall 23 is curved upwardly and outwardly and has its outer peripheral portion curved downwardly to provide an annular lip 25 extending therearound, the upper portion of which is disposed preferably at about the level of the upper end of the stack section 20. The wall 23 fits snugly in an opening 26 in the roof 14 and its outturned flange 25 engages over and against a portion of the roof 14 surrounding said opening 26. The lower end of the

upper stack section **20** is turned inwardly and upwardly to form an annular upwardly opening internally disposed gutter **27**. The upper end of the lower stack section **19** fits around the outer portion of the lower end of the upper stack section and may be flared outwardly slightly, as indicated at **28**, for engagement therewith. The upper stack section **20** is preferably braced to be maintained rigidly in an upright position by a plurality of braces **29** extending between the roof **14** and said stack section **20**.

Two or more collars **30** are disposed axially in the upper stack section **20** and are rigidly supported and secured thereto, each by a plurality of spokes or arms **31** which extend between the wall of said stack section and said collars and which are secured at their ends thereto, in any suitable manner.

A small relatively short tube or pipe **32** extends through a part of the lower stack portion **28** and into the gutter **27** and is inclined downwardly and outwardly from said gutter. A conduit **33**, which may be either a pipe or hose has an upper inner end connected to the lower end of the tube **32** and extends outwardly and downwardly therefrom through an opening **34** in the wall **16** so that the lower outlet end of the conduit **33** discharges externally of the enclosure **13**.

A jet-type tube, designated generally **35**, of a modified venturi construction is provided with a substantially cylindrical intermediate portion **36**. The jet tube **35** has an entrance end or mouth **37** forming a flared extension of one end of the intermediate portion **36** which is substantially in the form of a truncated cone, preferably having an angle of approximately 30° and the entrance end **38** of which is preferably of about three times the diameter of said intermediate portion **36**. The opposite end of the jet tube **35** is formed by a tube portion **39** which is likewise of a truncated conical form and which preferably has an outward flare of approximately 7°. A vane **40** which may be of any desired size and shape extends upwardly from said rear tube portion **39** and is suitably fixed thereto and disposed longitudinally thereof. The specific size and shape of the vane **40** and tube portion **39** may vary so long as the combined weight of said portions equals the weight of the inlet end portion **37** so as to balance the jet tube **35** intermediate of the ends of its intermediate portion **38**.

A tubular stack extension **41** has an upper end suitably secured to the bottom portion of the intermediate tube portion **36** and in communication therewith and is illustrated as being of approximately the same diameter as said tube portion **36**; however, the relative diameters of the tube portion **36** and stack extension **41** may vary. The stack extension **41** has a larger internal diameter than the stack section **20** and a smaller external diameter than the internal diameter of the wall **23** so that the lower portion thereof may be concentrically disposed between the upper end of the stack section **20** and the wall **23** and spaced substantially equal distances from said portions. The bottom portion of the flared inlet **37** is provided with an extension **42** at its inner end forming a lip which extends upwardly and inwardly a short distance over a portion of the upper end of the stack extension **41** which is located adjacent said inlet **37**, as best seen in Figures 1 and 4.

The lower end of a stationary shaft **43** is secured rigidly as by fastenings **44** in one or both of the collars **30** and extends upwardly therefrom axially of the stack **17**, centrally through the stack extension **41** and diametrically through the tube portion **36**. The upper part of the tube portion **36** is provided with an external enlargement forming a downwardly opening socket **45**, as best seen in Figure 3, for receiving the upper end of the shaft **43** and which may be provided with suitable antifriction thrust bearing means **46** for supporting the weight of the jet tube **35** and stack extension **41** on the shaft **43** and so that said parts may revolve freely about the shaft. The jet tube **35** is maintained steady with its axis at a

right angle to the axis of the stack **17** and in substantially a horizontal plane by a bearing **47** which is disposed centrally in the stack extension **41** above the upper end of the stack section **20** and which is journalled on the shaft **43**. Three or more threaded rods **48** are fixed to and extend radially from the bearing **47** outwardly through the stack extension **41** and have nuts **49** threaded thereon and bearing against the outer side of said stack extension. The rods **48** may be suitably secured to the bearing **47** after the rods are positioned in the stack extension. The material of the stack extension has sufficient give so that one or more of the nuts **49** may be loosened and the remaining nuts tightened for displacing the stack extension **41** to center its lower end between the wall **23** and the upper portion of the stack section **20**. The shaft **43** is of such a length as to support the lower end of the stack extension **41** slightly above and out of engagement with the channel bottom **24**. The channel **22** is filled to above the lower end of the stack extension **21** with a liquid **50** having a low freezing point and a specific gravity preferably greater than water.

Assuming that the inner enclosure **13** is filled with grain up to a level below the top of the wall **16**, and that the ventilator unit **12** is assembled in and on the bin or enclosure as illustrated in Figure 1, the vane **40** will hold the entrance mouth **38** of the jet tube **35** facing into the wind so that the air will blow directly into and through the tube from said entrance end toward its discharge end **39**. The air spaces or vents in most grains are equal to from **38** to **42** percent of the total volume of the mass and are considerably higher for ear corn. Grains are placed in storage bins or enclosures in the fall and invariably are quite moist and hot. To prevent spoilage and loss of a considerable part of the grain, grain must be cooled and preferably also dried. Expensive apparatus including drying equipment and blowers have been utilized for accomplishing these results to minimize grain spoilage. The present invention accomplishes both results without utilizing any power except that provided by the wind so that no expense is connected with the operation thereof. During daylight hours while the sun is shining on the bin or enclosure **13**, the walls thereof are heated heating the grain adjacent the walls and the hot air rises therefrom into the upper part of the bin while cooler air is drawn down through the bin adjacent its center. At night the walls of the bin or enclosure are cool so that the grain adjacent thereto is cooler than the grain adjacent the center of the bin and cool air descends from beneath the roof **14** toward the bin bottom **18** and additional cool air enters the bin through the inverted roof channels **15**.

The ventilator was tested over a winter season in an area where the wind velocity is quite low and averaged approximately eight miles an hour. However, the air entering through the inlet portion **37** is substantially compressed upon reaching the intermediate portion **36** so that if the mouth **38** is three times the diameter of the tube portion **36**, the velocity of the air entering at a speed of eight miles an hour will pass through the intermediate portion **36** at a speed of approximately seventy-two miles an hour so that a substantial suction will be created in the upper end of the stack and stack extension. Consequently, air at all times will be drawn downwardly through the grain and into the lower stack portion through the ports **21** and will then be drawn upwardly and discharged through the outlet portion **39**. Additional air will be drawn inwardly through the openings afforded by the inverted channels **15** to replace the air thus extracted from the enclosure **13**. This constant circulation of air through the grain will materially cool the grain and will also accomplish a constant but moderate drying of the grain, so that between the time the grain is placed in the bin in the fall and removed therefrom in the spring, approximately two-thirds of the moisture within the grain will have been removed and damage by spoilage will have been substantially eliminated.

The lip 42 further restricts the throat 36 of the tube 35 and deflects the air away from the upper end of the stack extension 41 to produce a low pressure area in the upper part of the stack extension and thereby increase the up draft or suction within the stack.

The liquid 50 forms a liquid seal between the stack section 20 and stack extension 21 to prevent air entering the stack extension through the channel 22 while permitting the jet tube 35 to rotate freely about the shaft 43. The liquid 50 has a low freezing point so that it will not freeze in cold weather. Rain water, condensation or other moisture will enter the channel 22 from the outer side of the stack extension 41 and condensation will also to some extent enter the channel 22 on the inner side of the stack extension. Agitation of the liquid 50 by rotation of the stack extension 41 will be sufficient to prevent this water from freezing but only a very small percentage of the liquid 50 will overflow with the water over the lip 25 onto the exterior of the roof 14 or over the upper end of the stack section 20 into the stack 17. The water thus entering the stack section 20 together with any other condensation which may directly enter said stack section will be caught in the gutter 27 and will drain therefrom through the drain conduit 32, 33 to be discharged externally of the enclosure 13. Thus, the ventilator stack and stack extension are effectively sealed against air entering said parts above the inlet ports 21 and effective drainage means is provided to prevent moisture entering the enclosure 13 through the ventilator. No rain, sleet or snow will enter the stack extension 41 from the tube throat 36 as the velocity of air passing through the throat 36 will carry rain and snow directly to the tube outlet 39.

Figures 8, 9 and 10 illustrate a slightly different form of the ventilator, designated generally 51, employed with a slightly different form of enclosure or bin, designated generally 52. The inner enclosure 52 is of a type which is sealed except for vent ports 53 which are located in the side wall 16*a* thereof adjacent the bottom 18*a*. Each of the vent ports 53 is preferably covered with heavy mesh wire fabric 54 to exclude rodents therefrom. Each of the openings 53 opens into an inverted channel or hood 55 which extends a substantial distance inwardly from the wall 16*a*. The hoods 55 are supported on blocks or legs 56 so that air may escape between the bottom 18*a* and the lower edges of the hoods 55. In lieu of the hoods 55, the enclosure or bin 52 may be provided with a conventional perforated subfloor disposed at approximately the level of the upper portions of said hoods or slightly above the openings 53, and which is conventional in many types of grain bins.

The bottom stack section 19 of the ventilator 12 is omitted from the ventilator 51 as all of the air enters the enclosure 52 adjacent its floor 18*a* and therefore passes upwardly through the grain or other material stored therein. Accordingly, the stack designated 20*a* constitutes a single section corresponding to the stack section 20 and which is similarly supported from the roof 14*a* by braces 29*a*. The stack 20*a* has a gutter 22*a*, corresponding to the gutter 22 and mounted in the same manner in an opening 26*a* of the roof 14*a*. The stack 20*a* is provided with an inturned gutter 27*a* at its lower end corresponding to the gutter 27 from which liquids are conveyed by gravity through a drain conduit 33*a*, the upper end of which opens into a portion of the gutter 27*a* and the lower end of which discharges externally of the wall 16*a*.

The ventilator 51 includes a long shaft 43*a*, the lower end of which has a base 57 which rests on the floor 18*a* and is secured thereto by fastenings 58 for supporting the shaft in an upright position axially of the stack 20*a*. The stack 20*a* is preferably provided with axially aligned collars 30*a* supported therein by arms or spokes 31*a*, corresponding to the collars 30 and spokes 31, respectively. The shaft 43*a* extends through said collars 30*a* and may be secured thereto as by setscrews 44*a*. The jet tube 35*a* is of somewhat different construction from the jet tube 35 and includes two portions 37*a* and 39*a* constituting truncated cones, the restricted ends of which are joined to form a throat 36*a*. The inlet tube portion 37*a* is tapered at a substantially greater angle than the discharge tube portion 39*a*. A vane 40*a* is mounted on the tube portion 39*a*, for the same purpose as the vane 40. The upper part of the tube portion 39*a*, near its restricted end, has an upstanding hollow portion forming a downwardly opening socket 45*a* for receiving the upper end of the stationary shaft 43*a* and which is provided with antifriction thrust bearing means 46*a*, corresponding to the antifriction thrust bearing means 46. The upper end of a stack extension 41*a* is secured to the bottom portion of the jet tube 45*a* intermediate of its ends and is connected to both the tube portions 37*a* and 39*a* and is sealed at its upper end except for an opening in the bottom of the discharge tube portion 39*a*, which opening 59 connects the interior of the stack extension 41*a* to the jet tube 35*a*. The bottom part of the inlet tube portion 37*a* at its restricted end and extending to the throat 36*a* forms a deflector lip 42*a*, for the same purpose as the lip 42. The stack extension 41*a* is shown as being larger in diameter than the throat 36*a*; however, said extension could be of the same diameter as the throat since the diameter thereof is not critical to the effective operation of the ventilator.

The extension 41*a* is provided with a centrally disposed bearing, not shown, which rotatably engages a portion of the shaft 43*a* and which is supported by radial threaded rods 48*a* and nuts 49*a*, in the same manner and for the same purpose as the rods 48 and nuts 49. The lower end of the stack extension 41*a* extends into the annular channel 22*a* and is spaced from the inner and outer walls thereof, in the same manner as previously described in reference to the ventilator 12. Likewise, said annular channel 22*a* is adapted to contain a liquid, not shown, corresponding to the liquid 50 and for the same purpose.

From the foregoing it will be readily apparent that the vane 40*a* will hold the mouth 38*a* of the entrance end 37*a* of the jet tube 35*a* facing into the wind so that the wind will blow therethrough. It will be obvious that the air will be compressed substantially between the mouth 38*a* and the throat 36*a* and accordingly will pass through the throat at a high velocity to create a substantial suction in the opening 59 and the stack and stack extension for effectively drawing air upwardly through the contents of the enclosure or bin 52 and into the lower end of the stack 20*a* and for creating a strong draft of air into the enclosure through its inlet openings 53. Lip portion 42*a* will additionally deflect the high velocity air upwardly and away from the opening 59 for producing a low pressure area above and adjacent said opening, for the same purpose as the deflector lip 42. Thus, the ventilator 51 will effectively function to maintain a circulation of air in the enclosure or bin 52 for cooling and drying the contents thereof with maximum efficiency since cooler air located adjacent the ground will always be entering the bottom of the enclosure while heated air within the enclosure and which would normally tend to rise will be drawn upwardly into the lower end of the stack 20*a*. In view of the detailed description of the ventilator 12 and enclosure 13, a further description of the ventilator 51 in its operation with the enclosure 52 is considered unnecessary.

Both forms of ventilators will also materially function in reducing damage to grain due to insects as the constant circulation of air through the enclosure is effective in removing insects from the grain and has resulted in effectively reducing damage normally caused to the grain by insects.

While the invention has been described with particular reference to grain bins, to which use it is particularly adaptable, it will be readily obvious that both forms of ventilators may also be utilized for ventilating other types of enclosures to cool the interiors of such enclosures and to reduce the humidity therein.

Various other modifications and changes are likewise contemplated and may obviously be resorted to, without departing from the spirit or scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. An enclosure ventilator comprising a stack adapted to be secured in substantially an upright position in an enclosure, the lower portion of the stack being in communication with the enclosure and the upper portion thereof being adapted to open upwardly through an opening in the enclosure roof, said upper stack portion comprising radially spaced annular wall portions and a bottom wall connecting said radially spaced wall portions and combining therewith to form an annular upwardly opening channel surrounding the upper end of the stack, a jet tube having an outwardly flared open entrance end and an outwardly opening discharge end flared to a lesser extent than said entrance end, said jet tube including a restricted intermediate portion, a stack extension secured to and depending from the intermediate portion of said jet tube and having an upper end opening into the jet tube through said intermediate portion thereof, a shaft extending upwardly from the stack through the stack extension into and transversely through said jet tube substantially intermediate of the ends thereof, means securing said shaft to the stack and supporting the shaft axially of the stack, said jet tube having a downwardly opening bearing socket in the upper part thereof rotatably receiving the upper end of said shaft for supporting the jet tube above the stack, said stack extension being larger in diameter than the stack and smaller in diameter than the outer one of said radially spaced walls and being supported by the shaft and jet tube with the open lower end thereof in said annular channel and spaced from the walls and bottom thereof, a liquid filling said channel to above the lower end of the stack extension and forming a liquid seal between the lower end of the stack extension and the upper end of said stack, and a vane secured to and projecting upwardly from the discharge end of the jet tube and extending longitudinally thereof for maintaining the flared entrance end of the jet tube facing into the wind, the outer one of said radially spaced walls having an outwardly and downwardly turned annular lip at its upper end adapted to be disposed directly over a roof portion surrounding the roof opening and having an outer edge resting on an upper surface of the roof.

2. An enclosure ventilator comprising a stack adapted to be secured in substantially an upright position in an enclosure, the lower portion of the stack being in communication with the enclosure and the upper portion thereof being adapted to open upwardly through an opening in the enclosure roof, said upper stack portion comprising radially spaced annular wall portions and a bottom wall connecting said radially spaced wall portions and combining therewith to form an annular upwardly opening channel surrounding the upper end of the stack, a jet tube having an outwardly flared open entrance end and an outwardly opening discharge end flared to a lesser extent than said entrance end, said jet tube including a restricted intermediate portion, a stack extension secured to and depending from the intermediate portion of said jet tube and having an upper end opening into the jet tube through said intermediate portion thereof, a shaft extending upwardly from the stack through the stack extension into and transversely through said jet tube substantially intermediate of the ends thereof, means securing said shaft to the stack and supporting the shaft axially of the stack, said jet tube having a downwardly opening bearing socket in the upper part thereof rotatably receiving the upper end of said shaft for supporting the jet tube above the stack, said stack extension being larger in diameter than the stack and smaller in diameter than the outer one of said radially spaced walls and being supported by the shaft and jet tube with the open lower end thereof in said annular channel and spaced from the walls and bottom thereof, a liquid filling said channel to above the lower end of the stack extension and forming a liquid seal between the lower end of the stack extension and the upper end of said stack, and a vane secured to and projecting upwardly from the discharge end of the jet tube and extending longitudinally thereof for maintaining the flared entrance end of the jet tube facing into the wind, said stack being formed of upper and lower sections, the lower end of the upper section of the stack being turned inwardly and upwardly to form an annular internal drain gutter, joint forming means connecting adjacent ends of the stack sections around said internal drain gutter, and a drain conduit having an upper end opening into said gutter and a lower end discharging externally of the enclosure.

References Cited in the file of this patent

UNITED STATES PATENTS

67,471	Wheeler	Aug. 6, 1867
328,818	Simpson	Oct. 20, 1885
718,186	Ashworth	Jan. 13, 1903
1,686,871	Meek	Oct. 9, 1928
2,142,724	Ferris	Jan. 3, 1939
2,242,310	Loy	May 20, 1941
2,357,705	Thorne	Sept. 5, 1944

FOREIGN PATENTS

459	Australia	Sept. 23, 1936
19,266	Great Britain	June 25, 1897
8,469	Great Britain	Apr. 7, 1893