Nov. 26, 1957 H. E. FORDYCE 2,814,435

FAN CYLINDER

Filed Oct. 19, 1953 2 Sheets-Sheet 1

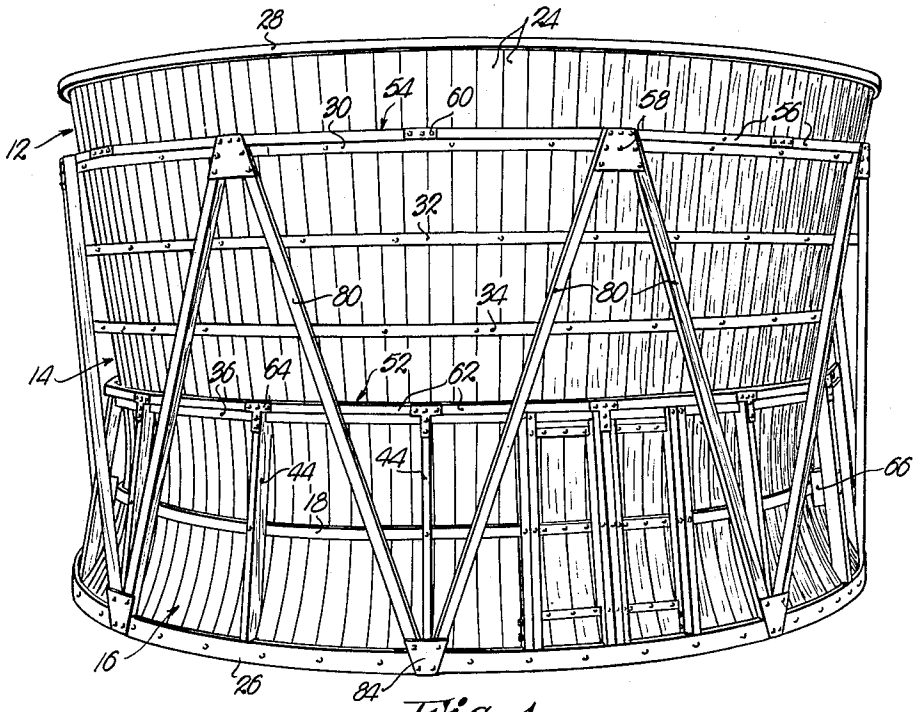


Fig. 1.

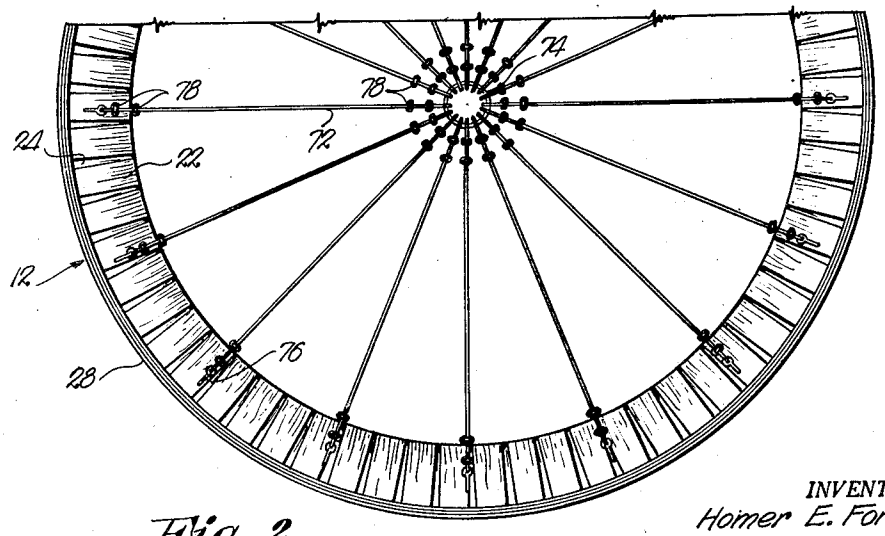


Fig. 2.

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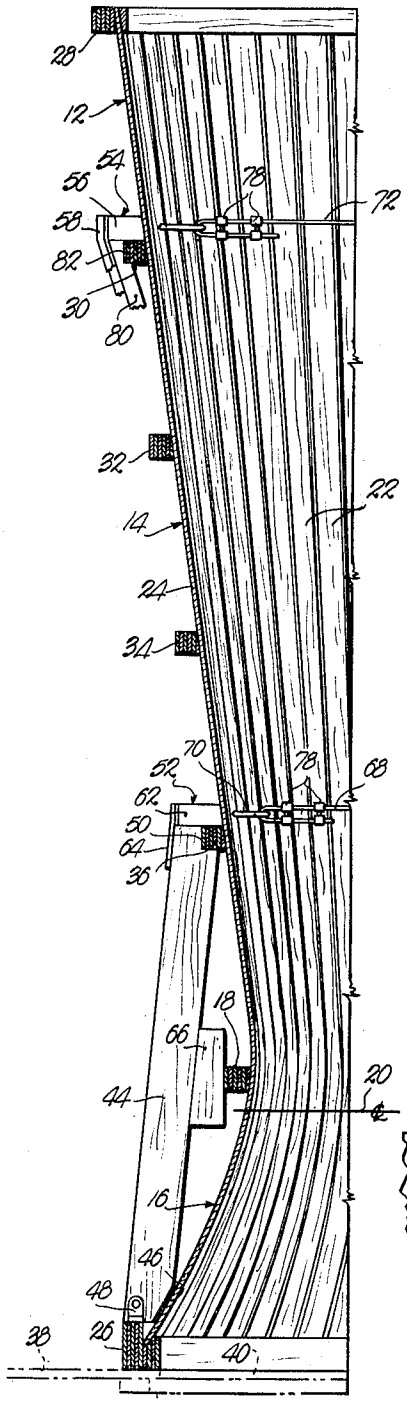


Fig. 3.

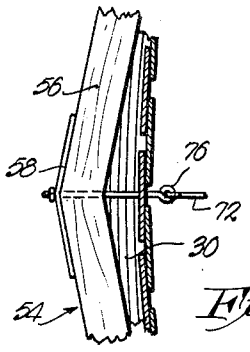


Fig. 4.

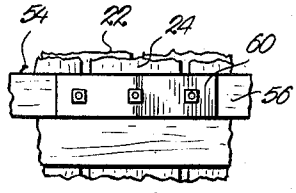


Fig. 5.

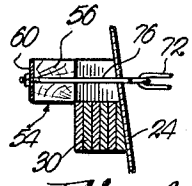


Fig. 6.

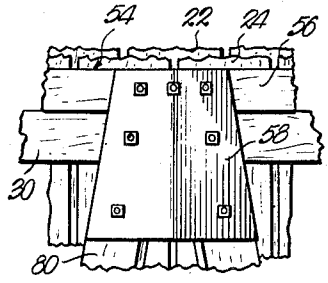


Fig. 7.

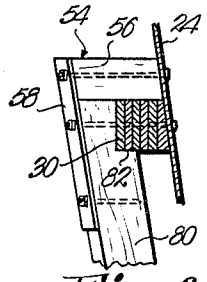


Fig. 8.

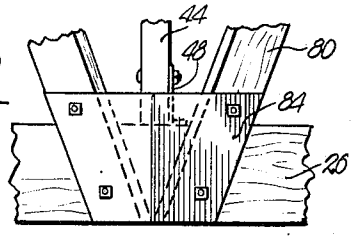


Fig. 9.

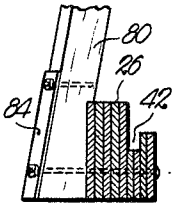


Fig. 10.

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2,814,435

FAN CYLINDER

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Application October 19, 1953, Serial No. 386,989

8 Claims. (Cl. 230—133)

This invention relates to improvements in water cooling towers, particularly those operating on a forced draft principle and including therefore, a fan for creating artificial currents of air and forcing the same through the splash decks of the tower to cool the water gravitating therein.

It is the primary object of the present invention to provide improved air flow structure including not only a fan ring but an outlet stack for hot air emanating from the tower as induced by the fan located within the ring, all for the purpose of rendering the operation of the tower more effective so far as cooling of the hot water is concerned.

It is the most important object of the present invention to provide a recover-type Venturi fan cylinder adapted for mounting on the top of a water cooling tower including a body having a stack combined with a fan ring formed to present a constriction to the flow of hot air emanating from the fan and to permit rapid and immediate reduction in pressure as the hot air emanates from the fan ring and is forced into the stack of the body.

Another important object of the present invention is to provide a combination fan ring and hot air outlet stack wherein the stack portion of the hollow body is not only integral with the fan ring, but extends well above the top of the tower so that the hot air is exhausted at a point far removed from the air inlet of the tower, thereby reducing the likelihood of the fan recirculating the hot air back through the splash deck of the water cooling tower.

Another object of this invention is to provide structure of the afore-mentioned character that is easily and inexpensively manufactured and yet sturdy, all through the inclusion of a novel arrangement of the staves forming the body, together with unique framework and reinforcement designed to hold the body in proper configuration and to prevent misalignment or other displacement of the parts thereof during long continued use.

Other objects include many important details of construction all of which will be made clear or become apparent as the following specification progresses.

In the drawings:

Figure 1 is a side elevational view of a fan cylinder made pursuant to the present invention.

Fig. 2 is a fragmentary, top plan view thereof.

Fig. 3 is an enlarged, fragmentary, detailed, vertical, cross-sectional view of the cylinder.

Fig. 4 is an enlarged, detailed view partially in horizontal section illustrating a portion of the uppermost body encircling band.

Fig. 5 is an enlarged, fragmentary, detailed, elevational view similar to Fig. 1, illustrating the manner of connecting the linear sections of the uppermost body encircling band.

Fig. 6 is a detailed, vertical, cross-sectional view through the uppermost band illustrating the manner of attaching its reinforcing rods thereto.

Fig. 7 is an enlarged, fragmentary, detailed, elevational view of the uppermost end of one of the A-frames.

Fig. 8 is a detailed view partially in vertical cross-section showing the manner of connecting the upright beams of the A-frames.

Fig. 9 is an enlarged, detailed, elevational view showing the way in which the lowermost ends of the said beams and the fan ring studs are mounted; and

Fig. 10 is a detailed view partially in vertical section showing the connection between the lowermost ends of the beams and the bottom body encircling hoop.

It is recognized that in the field of water cooling towers there is commonly provided a fan-encircling ring having a constriction to the flow of hot air emanating from the tower and motivated by the operation of the rotating fan. Such construction is shown in my U. S. Letters Patent No. 2,681,179, issued June 15, 1954, this being a continuation-in-part thereof.

It has also been previously suggested that there be included in water cooling towers, an upright stack for carrying the hot air away from the fan, well beyond the air inlet of the tower so as to reduce the tendency of recirculation. For the most part, however, each of these two desirable features have heretofore been separate so far as construction is concerned and the stacks normally employed are truly cylindrical, making it impossible for the air pressure to reduce until the hot air actually escapes from the stack at its uppermost end.

As is apparent from the drawings, the construction herein contemplated provides for a stack having a fan ring integral therewith, a constriction to the free flow of air emanating from the fan, and a configuration so far as the stack itself is concerned such as to permit rapid expansion, and therefore, reduction in the pressure of the hot air immediately as it emanates from the fan operating within the conoidal ring.

Accordingly, the combination fan ring and hot air outlet stack of the present invention consists of a hollow, upright body 12 that is tubular throughout its length and of circular, cross-sectional configuration from the lowermost open end thereof to the uppermost open end of body 12.

Body 12 consists of a frusto-conical stack 14 having an outwardly and downwardly flared skirt 16 at the bottom thereof, presenting a relatively short conoidal fan-receiving throat. The greatest diameters of the body 12 are at the uppermost and lowermost ends thereof and in the form of the invention chosen for illustration, the uppermost hot air outlet end of the body 12 may be of slightly greater diameter than that of the open inlet end at the bottom of the throat 16.

The body 12 has its smallest diameter adjacent a circumscribing hoop 18 at the line of juncture integrally interconnecting the stack 14 and the throat 16, presenting a constriction to the flow of hot air emanating from the underlying water cooling tower (not shown) and forced upwardly through the body 12 by the operation of such fan. It is contemplated that the fan be mounted for rotation on a vertical axis within the throat or skirt 16 substantially on a center line 20 spaced slightly below said line of smallest diameter as illustrated in Fig. 3 of the drawings.

The stack 14 of body 12 gradually and uniformly expands from the hoop 18 to the uppermost end thereof and as clear from Figs. 1 and 3 of the drawings, the stack 14 is of appreciably greater height than the skirt 16 so that all of the hot air emanating from the body 12 is carried upwardly well beyond the underlying tower, thereby virtually eliminating any chance of recirculation of the hot air by the fan within the throat 16.

Such funnel-form configuration of the stack 14 and the conoidal shape of the skirt 16 is easily and inex-

pensively produced by proper choosing of the material from which the body **12** is made and to this end there is included an innermost layer of staves **22** and an outermost layer of staves **24** wherein all of the staves are of bendable material such as redwood or other suitable substance.

It is to be noted that the staves **22** and **24** are all transversely horizontal and extend in length from a lowermost hoop **26** forming the lowermost open end of the body **12** to an uppermost circular hoop **28** forming the hot air outlet opening of the structure. As is particularly clear in Figs. 2 and 4 of the drawings, the staves **24** are so arranged as to break joint with the staves **22** forming the innermost layer. All of the staves **22** and **24** are bolted, nailed, screwed or otherwise attached directly to all of the circumscribing hoops including hoops **13**, **26** and **28** previously mentioned, together with intermediate hoops **30**, **32**, **34** and **36**.

It is contemplated that the entire structure forming the subject matter of the present invention be so designed as to permit construction at the site of installation and upon the cooling tower with which the same is to be associated. Accordingly, all of the circular hoops that circumscribe the body **12**, are likewise made of flexible strips of various lengths, bendable into the arcuate configuration illustrated in Fig. 2 and laminated to present a strong reinforcement and means of attachment for the staves **22** and **24**.

The lowermost hoop **26** may be bolted or otherwise affixed directly to the uppermost wall **38** of a cooling tower in direct alignment with the air outlet opening **40** thereof and is so designed as shown in Figs. 3 and 10, to present an upwardly facing annular groove **42** for receiving the lowermost ends of the staves **22** and **24**. When the series of laminations of the hoop **26** are interconnected and attached to the wall **38** of the cooling tower, the groove **42** adequately holds the lowermost ends of the staves **22** and **24** from movement or displacement radially inwardly or outwardly with respect to the vertical axis of the body **12**. The uppermost ends of the staves **22** and **24** are likewise preferably interleaved in the hoop **28** as shown in Fig. 3 and attached thereto by the same means that serves to hold the laminations of the hoop **28** together.

It is obvious that the greatest amount of outward thrust radially is against the hoop **18** and, therefore, a relatively strong reinforcement or holding framework is provided therefor. Such framework includes a plurality of upright studs **44** spaced apart and arranged in a circular series around the body **12** and particularly in encircling relationship to the hoop **18**. The elongated studs **44** are cut away as at **46** adjacent their lowermost ends to clear the skirt **16** and are joined rigidly to the lowermost hoop **26** through the medium of L-shaped brackets **48** connected with the studs **44** and with the hoop **26** by bolts or other fastening elements. The hoop **36** is in turn fitted tightly within notches **50** formed at the uppermost ends of the studs **44** and the latter are in turn secured to the body **12** at their uppermost ends by joinder to a body-encircling band **52**.

A similar band **54** surrounds the body **12** and particularly the stack **14** thereof immediately above the hoop **30** and is best seen in Fig. 4 of the drawings. Band **54** consists of a plurality of relatively short, linear sections **56**. The sections **56** are in abutting relationship and are interconnected by a plurality of trapezoidal plates **58**, as well as by alternate rectangular plates **60** as shown by Figs. 7 and 5 respectively.

Sections **62**, similar to the sections **56**, form the band **52** and the relatively abutting sections **62** are likewise interconnected by T-shaped plates **64**, plates **64** also serving to join the studs **44** to the band **52**. Accordingly, as shown in Fig. 1 of the drawings, there is a T-shaped plate **64** for each stud **44** respectively.

A short block **66** is interposed between each stud **44** respectively and the hoop **18** and common fastening means may be employed to interconnect the studs **44**, their blocks **66**, the hoop **18** and the body **12** at the zone of juncture between the stack **14** and the skirt **16**.

It is thus seen that by virtue of the flexible or bendable characteristics ofthe staves **22** and **24** forming the body **12**, the latter is bent inwardly and held in such position by the action of the studs **44** acting on the ring **18** through the blocks **66**. While the staves **22** and **24** are preferably straight throughout their lengths from adjacent the hoop **18** to the hoop **28**, the hoop **18** holds the staves **22** and **24** longitudinally arched adjacent thereto, and it is to be preferred further that the diameter of the lowermost hoop **26** be such as to provide a gentle curve longitudinally in the staves **22** and **24** between the hoops **18** and **26**.

The blocks **66** are held tightly against the periphery of the hoop **18** and the studs **44** are held against outward radial movement by reinforcing structure within the body **12** that connects with all of the sections **62** of the band **52**. Such reinforcing structure includes a plurality of cables **68** each connecting with an eye-bolt **70** extending through the body **12**, through the band **52**, and the plates **64**.

Similar reinforcing structure is provided for the band **54** and which includes a plurality of cables **72** joined at their innermost ends to a central ring **74** and at their outermost ends to eye-bolts **76**. As shown in Figs. 4 and 6, the eye-bolts **76** extend through the body **12**, the band **54** and plates **58** or **60** as the case may be. The cables **68** are secured to an innermost ring (not shown) similar to the ring **74** and all of the cables **68** and **72** are provided with clamps **78** both at the centermost rings and at the eye-bolts to permit take-up and, therefore, maintainance of the respective bands **52** and **54** tightly against the outer surface of the body **12**.

The entire body **12** is further supported and reinforced by a plurality of upright A-frames throughout the circumference of the body **12** and each including a pair of elongated beams **80** converging as the uppermost ends thereof are approached. The ring **54** rests directly upon the uppermost ends of the beams **80** and, as shown in Figs. 3 and 8 of the drawings, the hoop **30** is partially cleared through the medium of notches **82** in the uppermost ends of the beams **80**. Beams **80** are interconnected and joined to the hoop **30** by bolts or the like that pass through the corresponding plates **58**. Similarly, plates **84** interconnect the beams **80** at their lowermost ends and join the latter with the hoop **26** as shown in Figs. 9 and 10 of the drawings.

It is seen that by provision of the beams **80**, the entire weight of the body **12** is not supported entirely by the lowermost ends of the staves **22** and **24** resting within the groove **42**. The studs **44** likewise serve the additional function of receiving downward thrust of the body **12** together with the weight of the various structural parts associated therewith and hereinabove identified.

Through use of the plurality of hoops **18**, **26**, **28**, **30**, **32**, **34** and **36**, together with bands **52** and **54**, when considered in connection with the supporting and reinforcing framework that includes studs **44** and beams **80**, the entire structure is adequately tied together as a unit and any tendency of the body **12** to twist or become otherwise misshapen is further eliminated by the equalized force of the connecting cable structure **68**—**72**.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In combination, a tubular body including a plurality of elongated, initially flat, flexible staves; a pair of spaced retainers operably connected with the body for holding the staves against inward radial movement adjacent each retainer; and a hoop surrounding the body in engagement with the staves between the retainers, the diameter of the hoop being less than the diameter of the body at said retainers whereby the hoop holds the staves tensioned

inwardly and longitudinally arched between the retainers.

2. In combination, a tubular body including a plurality of elongated, initially flat, flexible staves; a pair of spaced retainers operably connected with the body for holding the staves against inward radial movement adjacent each retainer; a hoop surrounding the body in engagement with the staves between the retainers, the diameter of the hoop being less than the diameter of the body at said retainers whereby the hoop holds the staves tensioned inwardly and longitudinally arched between the retainers; and means for holding the hoop against increasing in diameter.

3. In combination, a tubular body including a plurality of elongated, initially flat, flexible staves; retention means holding the staves against inward radial movement at one end of the body; a hoop surrounding the body and secured thereto for holding the staves against inward radial movement adjacent said hoop; and stave-deforming means including backing means interconnecting the hoop and said retention means, and structure interposed between the body and said backing means for holding the staves tensioned inwardly and longitudinally arched between the hoop and the retention means.

4. In combination, a tubular body including a plurality of elongated, initially flat, flexible staves; retention means holding the staves against inward radial movement at one end of the body; a first hoop surrounding the body and secured thereto for holding the staves against inward radial movement adjacent said first hoop; and stave-deforming means including a second hoop of lesser diameter than said first hoop and surrounding the body between the first hoop and said retention means for holding the staves tensioned inwardly and longitudinally arched between the first hoop and the retention means, and backing means interconnecting the first hoop and the retention means for holding the second hoop against increasing in diameter.

5. In combination, a tubular body including a plurality of elongated, initially flat, flexible staves; a pair of spaced retainers operably connected with the body for holding the staves against inward radial movement adjacent each retainer; a hoop surrounding the body in engagement with the staves between the retainers, the diameter of the hoop being less than the diameter of the body at said retainers whereby the hoop holds the staves tensioned inwardly and longitudinally arched between the retainers, said staves extending beyond one of said retainers presenting a frusto-conical stack portion progressively decreasing in diameter as said one retainer is approached; and means for holding the staves along said stack portion against radial movement.

6. In combination, a tubular body including a plurality of elongated, initially flat, flexible staves; a pair of spaced retainers operably connected with the body for holding the staves against inward radial movement adjacent each retainer; a hoop surrounding the body in engagement with the staves between the retainers, the diameter of the hoop being less than the diameter of the body at said

retainers whereby the hoop holds the staves tensioned inwardly and longitudinally arched between the retainers, said staves extending beyond one of said retainers presenting a frusto-conical stack portion progressively decreasing in diameter as said one retainer is approached; and a plurality of hoops surrounding the body along said stack portion for holding the staves against radial movement, said hoops progressively decreasing in diameter as the first-mentioned hoop is approached.

7. In combination, an elongated, tubular body having a frusto-conical stack portion, progressively increasing in diameter as one end of the body is approached, and a skirt portion integral with the stack portion at that end of the latter opposite to said one end of the body, said skirt portion being outwardly flared, and, therefore, progressively increasing in diameter as the opposite end of the body is approach; a plurality of hoops surrounding the stack portion and progressively increasing in diameter as said one end of the body is approached, the hoop of smallest diameter holding the body against increasing in diameter adjacent thereto, said body including a plurality of initially flat, elongated, flexible strips secured to the remaining hoops whereby the latter hold the strips against inward radial movement; and retainer means for holding the strips against inward radial movement at said opposite end of the body.

8. In combination, an elongated, tubular body having a frusto-conical stack portion, progressively increasing in diameter as one end of the body is approached, and a skirt portion integral with the stack portion at that end of the latter opposite to said one end of the body, said skirt portion being outwardly flared, and, therefore, progressively increasing in diameter as the opposite end of the body is approached; a plurality of hoops surrounding the stack portion and progressively increasing in diameter as said one end of the body is approached, the hoop of smallest diameter holding the body against increasing in diameter adjacent thereto, said body including a plurality of initially flat, elongated, flexible strips secured to the remaining hoops whereby the latter hold the strips against inward radial movement; retainer means for holding the strips against inward radial movement at said opposite end of the body; and a number of load-bearing members depending from and in supporting relationship to one of the larger hoops.

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