

[54] APPARATUS FOR MIXING AIR AND STEAM FOR DELIVERY TO A DRYER

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[58] Field of Search 34/48, 49, 72, 83, 84,
34/119, 122, 124, 125; 261/118, 77, 79 A;
165/89, 90, 91

[57] ABSTRACT

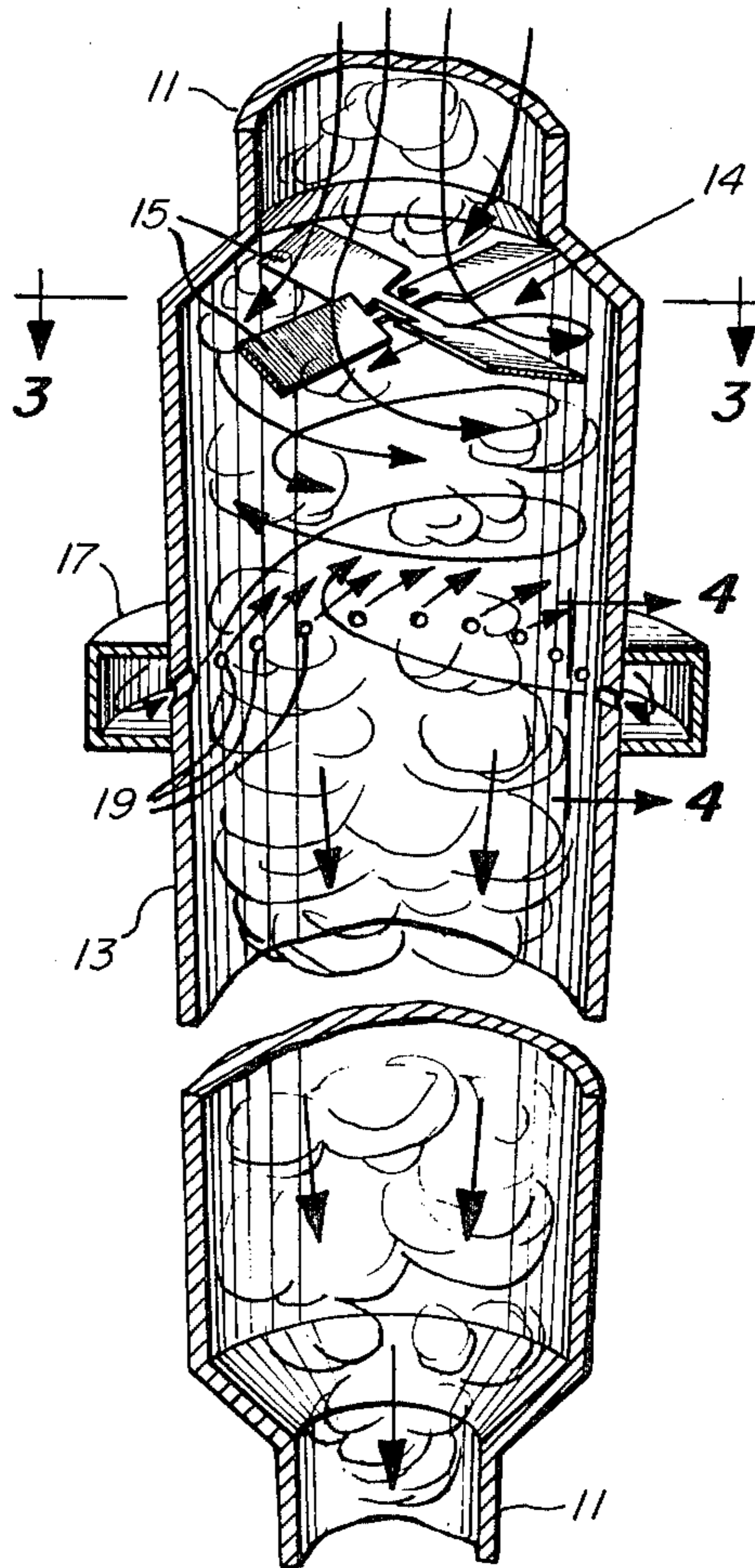
A device for mixing air with steam has a mixing chamber with inlet means to cause the entering steam to spin and air delivery means delivering an annular series of air streams into the chamber directed towards the inlet and to spin counter to the spinning steam streams.

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3 Claims, 4 Drawing Figures



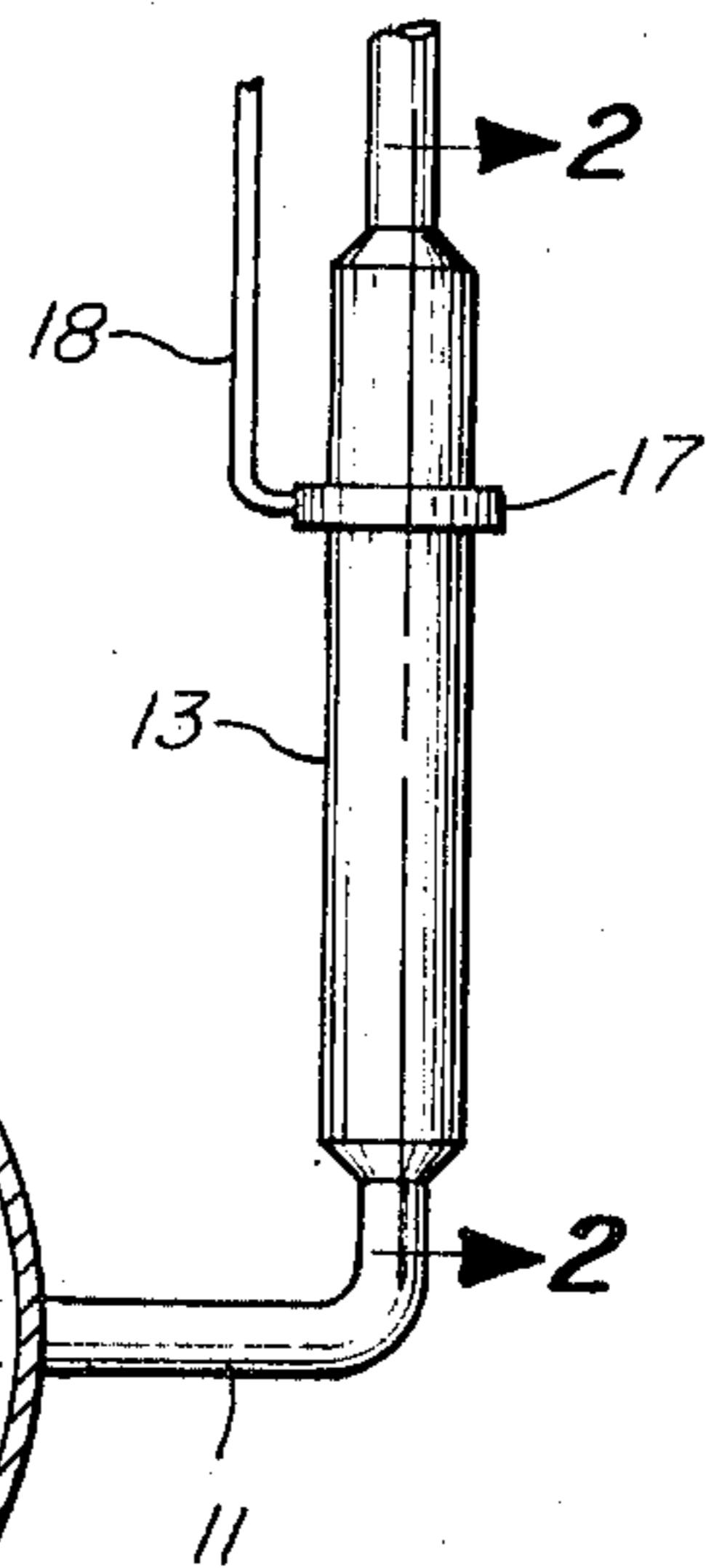


FIG. 1

FIG. 2

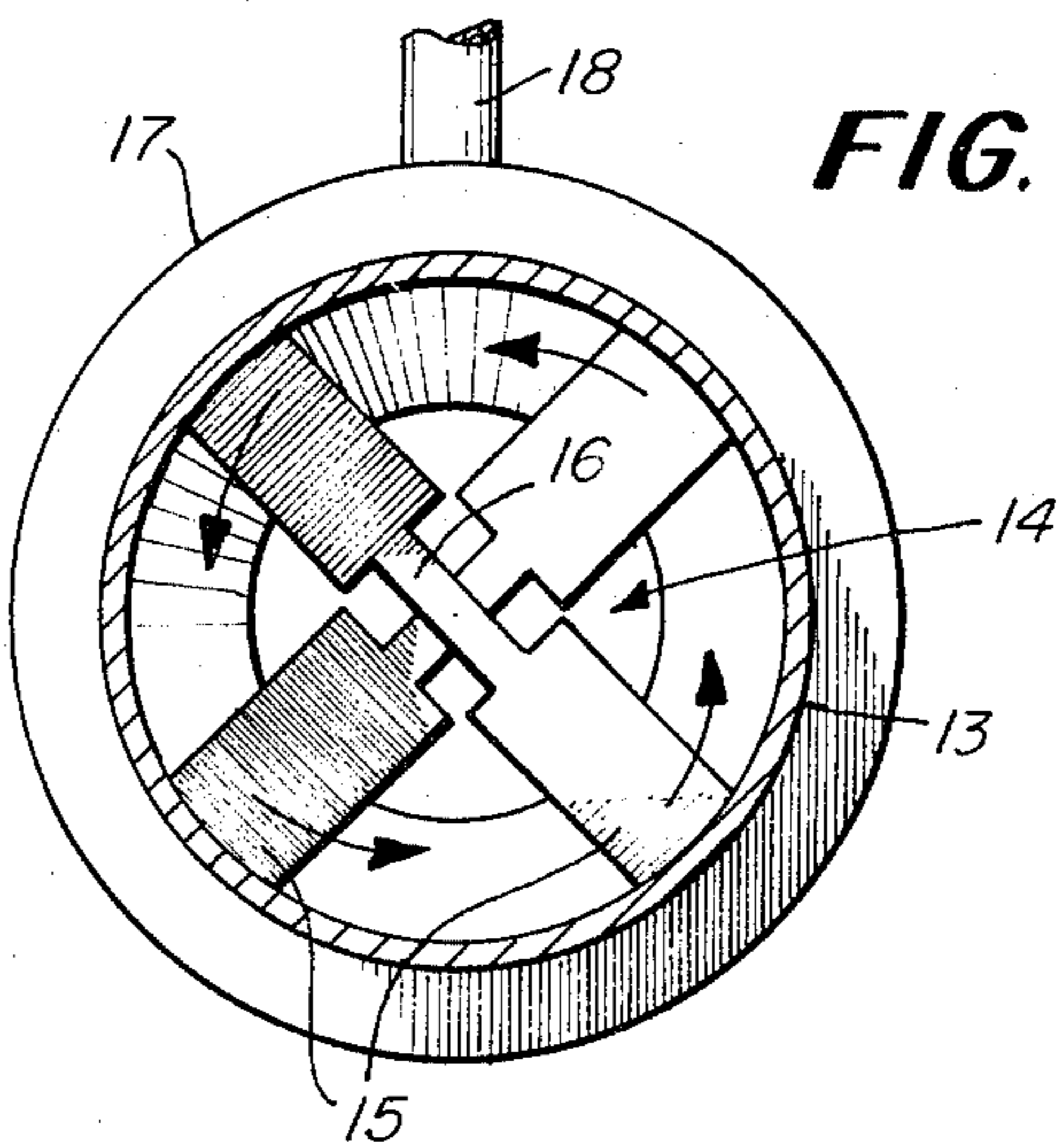
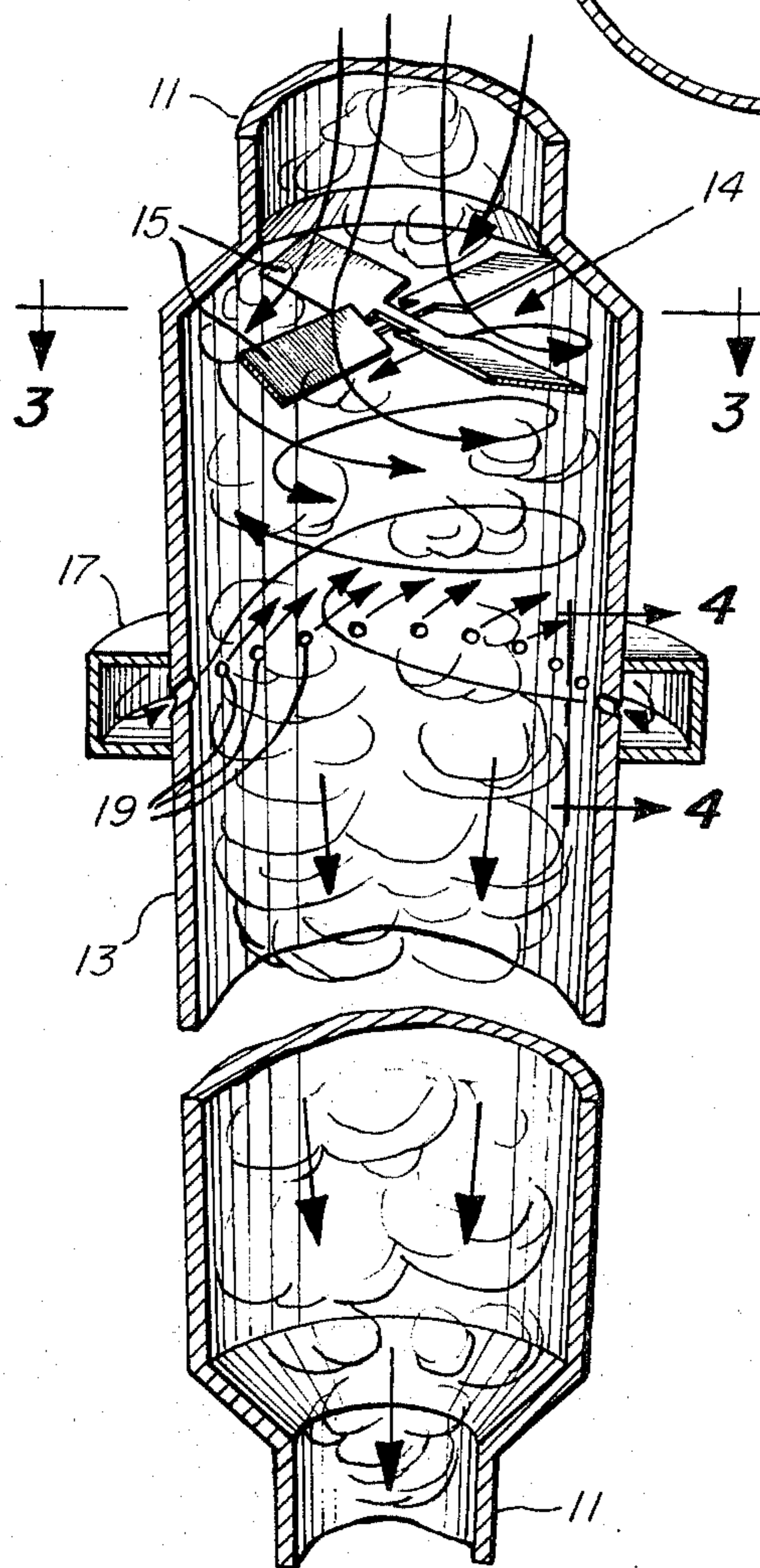


FIG. 3

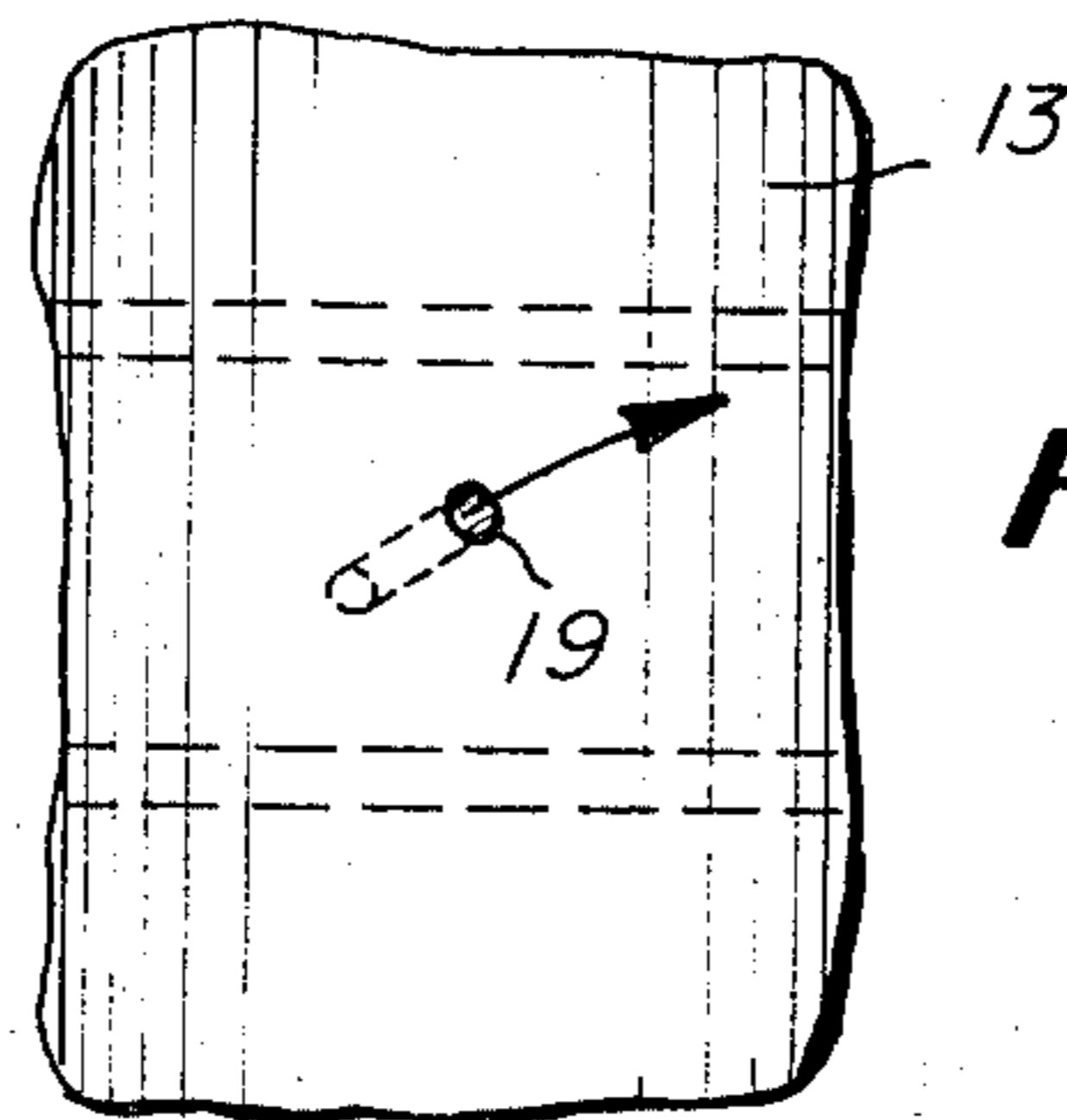


FIG. 4

APPARATUS FOR MIXING AIR AND STEAM FOR DELIVERY TO A DRYER

BACKGROUND OF THE INVENTION

In the drying of continuous sheets, for instance, paper, it is often necessary that certain dryer sections, typically a series of cylinders, be operated at temperatures somewhat lower than can be achieved with steam at or close to the pressure of one atmosphere (zero gauge pressure).

Such somewhat lower temperatures have been attained by providing a vacuum on the drainage side of the steam heated dryer section. One way the vacuum is produced is by condensing steam, a procedure requiring that large quantities of heat be passed off to the condenser cooling water and the heated water often used for other process requirements. There is, however, a net loss of energy arising from the use of a condenser, if not all the heat lost in the course of the drying process is utilized in one way or another. The use of a vacuum pump, while permitting the heat required by the operation of a condenser to be otherwise usefully employed, requires additional energy.

Even lower steam temperatures can be provided within the steam heated drying components by introducing air into them. When this is done, less energy is consumed than when vacuum is employed. With the use of air, however, the steam and air must be well mixed to ensure that all areas of the surfaces engaged by the sheet material reach the same temperature thus to avoid unequal heating of such surfaces being the cause of defects in the processed material.

THE PRESENT INVENTION

The general objective of the present invention is to enable steam temperatures to be reduced by air while providing uniformity in the temperatures of the surface of each drying component.

In accordance with the invention, this objective is attained by providing a device in the steam delivery line to a drying component that effectively mixes the air and steam so that the delivered mixture is of a uniform temperature. The device consists of a chamber in the air delivery conduit with means in its infeed end to cause the entering steam to spin in one direction. The device also includes means to deliver air into the chamber as an annular series of streams directed towards the inlet and to spin in a direction counter to the steam.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, a preferred embodiment of the invention is shown with

FIG. 1 is a side elevation of the steam-air mixer incorporated in the line delivering steam to a drying component, a schematically illustrated cylinder of a paper making machine;

FIG. 2 is a section in perspective and on an increase in scale, taken approximately along the indicated line 2—2 of FIG. 1;

FIG. 3 is a section taken approximately along the indicated line 3—3 of FIG. 2; and

FIG. 4 is a fragmentary view of the interior of the chamber showing one of the air inlet ports.

THE PREFERRED EMBODIMENT OF THE INVENTION

One cylinder or drum of a dryer is schematically

shown in FIG. 1 and generally indicated at 10. Such a cylinder is typical of those used in dryers where two series of such cylinders are provided with the sheet material disposed with one surface in engagement with the cylinders of the other series. The cylinders 10 are steam heated and their temperature is commonly controlled in groups. Each cylinder receives steam from a suitable source through a delivery conduit 11 placed in communication with its interior by an axially located rotary joint generally indicated at 12.

In accordance with the invention, a delivery line 11 to a cylinder 10 has a mixing chamber 13 incorporated in the delivery conduit 11 and the chamber 13 has, adjacent its inlet end, means, generally indicated at 14, to cause the entering steam to be divided into streams that spin in a predetermined direction. The means 14 is shown as consisting of two pairs of blades 15 with each pair interconnected by a web 16 and with the webs 16 crossed. The outer ends of the blades 15 are welded or otherwise secured to the inner surface of the chamber wall and the blades 16 are appropriately inclined, say 10° - 15° from a plane lengthwise of the chamber, to divide the steam into spinning streams. The chamber 13 is shown as of substantial length, typically three to five feet and its diameter is somewhat greater than but desirably not more than twice that of the steam conduit 11.

A narrow chamber 17 encircles the chamber 13 and is located, for best results, in the approximate range of 20 to 30 percent of the length of the chamber 13 as measured from its inlet end. A conduit 18 for a source, not shown, of air under pressure greater than the stream pressure is in communication with the chamber 17 and a circumferential series of ports 19 effect communication between the chambers with the ports 19 disposed to create a series of air streams each directed towards the inlet and to spin in a direction counter to the spinning steam streams.

In operation, it will be apparent that the two counter-flowing and counter-rotating fluids become thoroughly mixed, a result abetted by the length of the chamber 13, and, as a consequence, the temperature of the steam is suitably lower but is so uniform that each cylinder 10 provides uniform temperature transversely of the sheet being dried.

While reference has been made to the temperature of the cylinders 10 being controlled by groups, the invention may be employed to effect the reduction of the steam temperature of the cylinders individually.

I claim:

1. Apparatus for mixing air and steam for delivery to a dryer, said apparatus including a steam supply conduit in communication with the interior of a cylinder of said dryer, a cylindrical chamber of substantial length in said conduit, means in the inlet end of said chamber to cause the entering steam to spin in one direction, and means to deliver air under pressure into said chamber as an annular series of streams directed towards said inlet and to spin in the opposite direction relative to the steam, the cross sectional area of the chamber being enough greater than that of the steam conduit to prevent said steam spinning means from being a restriction.

2. The apparatus of claim 1 in which the annular series of streams enter the chamber in a zone located within the approximate range of 20 to 30 percent of the length of the chamber as measured from the inlet.

3. The apparatus of claim 1 in which the air delivery means includes a chamber encircling the mixing chamber with the wall of the mixing chamber common thereto having a circumferential series of air stream creating ports therein.

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