

Dec. 17, 1946.

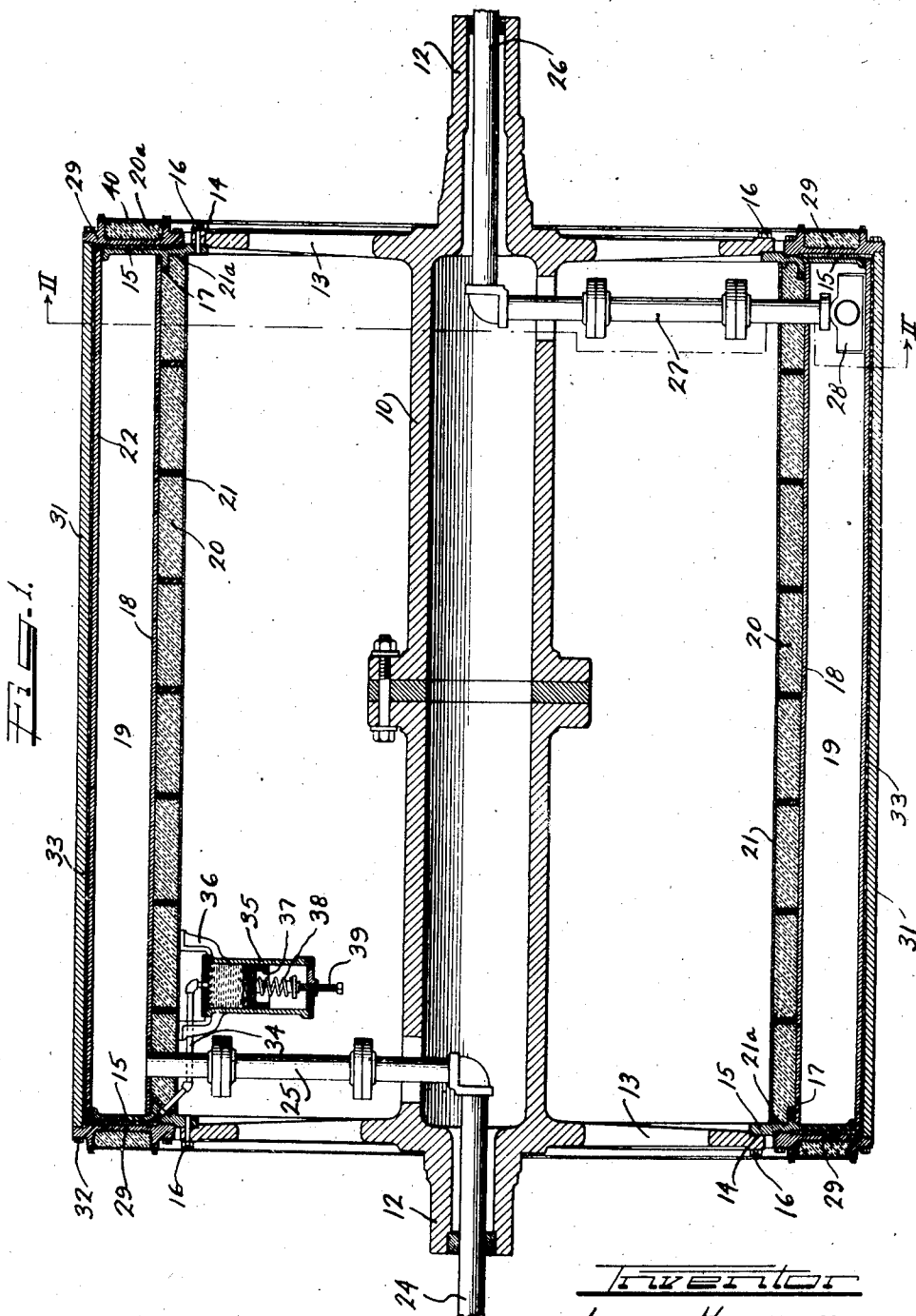
L. HORNOSTEL

2,412,733

DRIER DRUM

Filed Jan. 29, 1944

2 Sheets-Sheet 1



LLOYD HORNOSTEL.

Charles Hill

Dec. 17, 1946.

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Fig. 2.

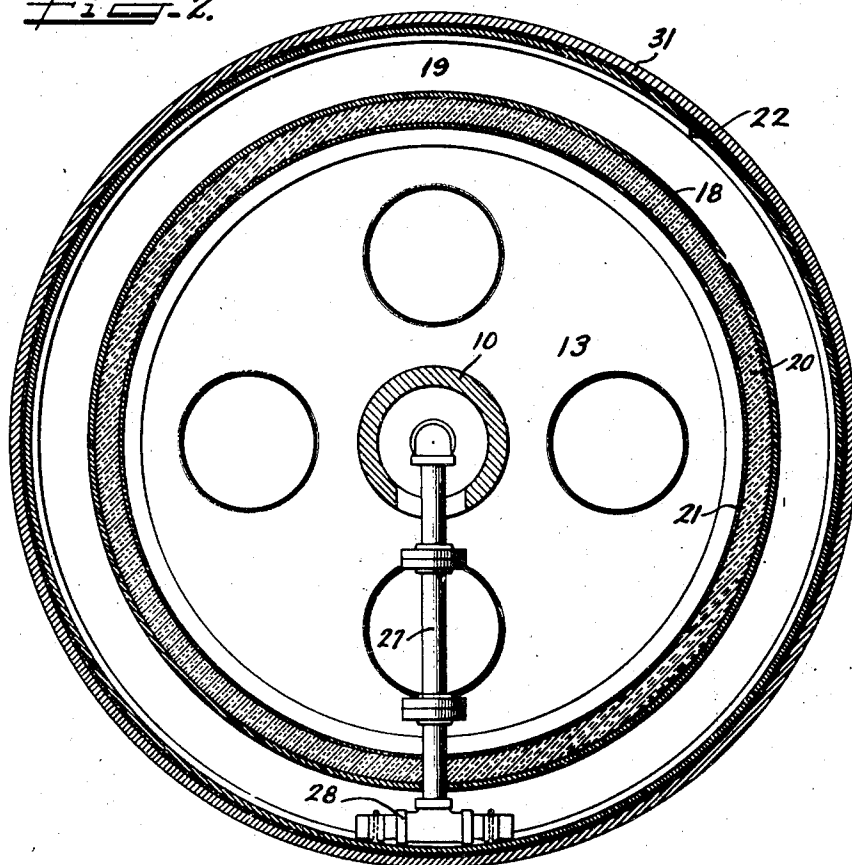
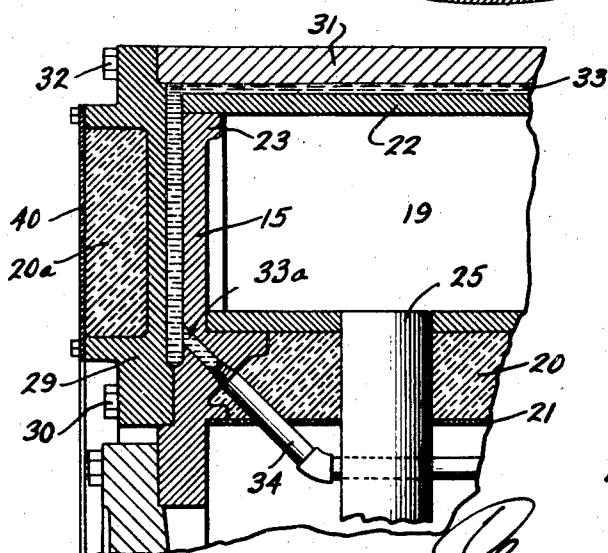


Fig. 3.

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UNITED STATES PATENT OFFICE

2,412,733

DRIER DRUM

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Application January 29, 1944, Serial No. 520,188

2 Claims. (Cl. 257—95)

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This invention relates to a drier drum, the cylindrical drying surface of which has the desired characteristics of hardness and smoothness, the drum assembly, at the same time, being constructed to permit of efficient operation at extremely high fluid pressures.

Drier drums of the general type here under consideration are often used in the drying of paper after the sheet or fiber web has been formed on a paper making machine. In order to secure the desired surface on the sheet that is so dried (for example in the production of a so-called "machine glaze" sheet), it is desirable that the surface of the drier drum or cylinder be homogeneous and machinable to a high degree of regularity and smoothness. At the same time, it is necessary that the surface be very hard and durable, to effectively withstand the action of doctors and other mechanism necessarily brought into contact therewith.

Cast iron provides an admirable metal for this purpose, but the physical strength thereof is so low that too great a thickness of metal is required to withstand the extremely high pressures desirable for efficient drying operation. Cast steel does not provide the desired surface characteristics, and the heat treatment or case hardening thereof has proven impracticable with the large size drums or cylinders required for driers of this character.

It is an important object, therefore, of the present invention to provide a drier drum assembly wherein a cast iron outer shell is backed by a spaced inner steel shell adapted to withstand extremely high heating fluid pressures, said outer and inner shells being maintained in uninterrupted heat conducting relation by a body of fluid of high heat conductivity which fills the space therebetween.

It is a further important object of this invention to provide a drier drum of the kind described wherein surges in the heat-conducting fluid are accommodated by a surge chamber elastically variable in effective size.

It is also an important object of this invention to provide a drier having an outer element affording desired surface characteristics, an inner element spaced from the outer element and adapted to withstand high heating fluid pressures, with a body of liquid of high heat conductivity filling the space between such elements.

Other and further important objects of this invention will be apparent from the following specification and claims, and the accompanying drawings.

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On the drawings:

Figure 1 is a central longitudinal sectional view with parts shown in elevation showing a drier drum or cylinder constructed in accordance with the present invention.

Figure 2 is a section on the line II—II of Figure 1.

Figure 3 is an enlarged fragmentary sectional view showing details of drum construction with particular reference to the interposition of the body of fluid of high heat conductivity.

As shown on the drawings:

The reference numeral 10 indicates a hollow axle member which is provided with bearing surfaces 12 to permit the mounting thereof for rotation and which is also provided at either end with supporting spiders 13 which carry the drying chamber in a manner that will now be described.

The spiders 13 are provided with shoulders as at 14 to engage complementary shouldered portions on cylindrical end plates or heads 15 which are secured to said spiders by bolts 16 engaged through the shouldered portions of the respective parts.

The inner faces of the heads or end plates 15 are provided with inwardly extending annular flanges 17 on which are carried an inner cylinder 18 which forms the inner wall of a steam chamber 19. The inner cylinder 18 is preferably formed of steel so as to withstand high fluid pressures and to prevent heat loss. At the side of the chamber defined by said inner wall 18, a layer of insulating material 20 is provided on the inside of the cylinder 18, said layer of insulation 20 being conveniently positioned by a supplemental cylindrical member 21 secured to and positioned by inwardly extending annular flanges 21a on the end plates 15.

The outer wall of the chamber 19 is provided by a cylindrical member 22 secured at its ends to the end plates or heads 15 in pressure-resisting relation by welding or otherwise. The cylindrical member 22 is preferably constructed of steel of such strength as to withstand high steam pressures. The end plates or heads 15 are preferably flanged as at 23 (see Figure 3) to provide greater support for the cylindrical member 22.

Superheated steam at extremely high pressure is introduced into the chamber 19 from a conduit 24 which leads in to the left-hand side of the hollow axle member 10 and has a lateral portion 25 extending into said steam chamber. The conduit 24 may be provided with the usual steam joint, not shown, to permit rotation there-

of but, since such steam joints are well known in the art and provide no part of the present invention, they will be neither shown nor described here.

An outlet whereby steam is conducted out of the steam chamber 19 comprises a conduit 26 extending outwardly through the hollow axle member shown at the right-hand side of Figure 1, said conduit 26 being provided with a lateral portion 27 extending into the steam chamber at the bottom thereof which is provided with the usual scoop type of outlet 28. The conduit 26 may be provided with the usual steam joint (not shown) to permit rotation in the manner above described.

In order to withstand the high steam pressures, the cylinders 18 and 22 are made of strong steel, so-called 31-40 steel having been found suitable for this purpose. While steel of this character is well adapted to withstand high steam pressures, it is not adaptable to providing the required smooth surface that at the same time is sufficiently hard to withstand the mechanical action of doctors, scrapers, and similar apparatus which may be engaged against the surface thereof in the paper making operation.

In order to provide the desired hard surface for engagement with the material to be dried, I provide an arrangement which is generally shown in Figure 1 and which is shown in detail in Figure 3.

Supplementary heads 29 are secured to a shouldered portion of the heads or end plates 15 as shown in Figure 3 by means of bolts 30, or in any other suitable manner, said supplementary heads or end plates 29 extending in a direction parallel to but spaced from the outer faces of the end plates 15.

The supplementary heads or end plates 29 project beyond the end plates 15 and are provided with annular shoulders on their inner faces to receive a cast iron cylinder 31 coaxial with the cylinder 22 but spaced therefrom as shown in Figures 1 and 3, said cast iron cylinder 31 being secured to the supplemental heads or end plates 29 by means of bolts 32. As previously noted, the cylinder 31 is made of cast iron which forms an admirable surface material for the drier drum and which may be machined to a requisite degree of smoothness and uniformity.

Since, in the drying operation, it is desirable to efficiently convey heat from the steam chamber 19 to the surface of the cylinder or drum 31, I have made provisions for the transmission of heat from the cylinder 22 to the cylinder 31 by filling the space between said cylinders and between the end plates 15 of the supplemental end plates 29 with a body of mercury or other low melting-point metal having a high degree of heat conductivity. I have also found the commercial product "Dowtherm" suitable for this purpose. This body of liquid or fluid material having a high degree of heat conductivity is designated on the drawings by the reference numeral 33.

In order to accommodate for variations in volume of the body of fluid 33, in order to compensate for surges in such body of fluid and to insure that the space occupied by such body of fluid be filled with fluid at all times, I have provided a surge chamber, elastically variable in capacity, in communication with the body of fluid 33 in a manner which will now be described. Formed in one of the end plates 15 is a passage 33a which opens into a conduit 34, the other end of which conduit communicates with the interior of a

closed cylinder 35 conveniently supported from the cylinder 21 by brackets 36 in the manner shown in Figure 1.

Mounted in the cylinder 35 is a piston 37 which is sealed in fluid-tight relation to the inner wall of said cylinder and which is urged toward the closed upper end of the cylinder by a spring 38. By virtue of this arrangement any expansion of the body of liquid will cause an increase in volume of the liquid in the cylinder 35, a movement of the piston 37 against the spring 38, and a consequent enlargement of the space above the piston within the cylinder. Similarly, a decrease in volume of the body of heat-conducting liquid will be compensated by an expansion of the spring 38 and a resultant movement of the piston 37 to reduce the volume of the liquid-containing chamber within the cylinder 35.

In order to provide for adjustment of the maximum enlargement of the chamber within the cylinder 35, an adjusting screw 39 is provided threaded in the lower end of the cylinder 35 as shown in Figure 1. When the adjusting screw 39 is rotated to move inwardly, the total maximum volume which may be provided within the cylinder 35 is reduced, and conversely, when the screw 39 is rotated in a reverse direction, the maximum effective volume is increased.

As shown in Figure 1 and Figure 3, the supplemental heads or end plates 29 may be provided with annularly extending recesses adapted to receive a body or layer of insulation 20a, the insulating material comprising the said layers 20a being conveniently held in contact with the said supplemental end plates by retaining plates 40 bolted thereto.

It will be apparent from the foregoing that the structure of this invention provides drying apparatus wherein high pressure steam is safely confined in steel cylinders that are adapted to withstand the high pressure thereof but wherein the surface contacted by the material to be dried is made of cast iron that is capable of being easily machined to the proper degree of regularity and smoothness and also provides the requisite hardness to withstand contact by doctors, scrapers and similar apparatus brought in contact therewith incident to the operation of the drier. By reason of the provision of the body of liquid of high heat conductivity, which is interposed between the outer steel cylinder 22 and the cast iron surface drum or cylinder 33, heat from the high pressure superheated steam in the chamber 19 is efficiently transmitted to the surface of said cylinder 33. The cylinder 35, with its spring-impelled piston 37 in communication with this body of liquid of high heat conductivity, affords a surge chamber which assures maintenance of a body of liquid of high heat conductivity in contact with the surfaces defining the space between cylinders 22 and 31 at all times so that efficient conduction of heat is uninterrupted.

By reason of the arrangement of this invention, it is possible to make an efficient drier structure which will operate with superheated steam under extremely high pressure and which, at the same time, may be made relatively light in weight due to the fact that the steam pressure is withstood by the relatively light steel cylinder, thus making it possible to use a cast iron contact cylinder which is much lighter in weight.

This invention, therefore, provides a drier structure of the type described which is relatively

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light in weight, inexpensive to construct, and efficient in operation.

While I have illustrated and described herein a preferred embodiment of the present invention, it is to be understood that this has been done by way of illustration, and that the invention is not to be specifically confined to such embodiment. For example, I have made reference to mercury, and to the product "Dowtherm" as satisfactory heat-conducting fluids. It is obvious that the principles of this invention are equally applicable when other fluids such as low melting-point metals having high heat conductivity are used to fill the space between the cylinders.

It is understood, therefore, that this invention includes every construction and method falling within the terms of any one or more of the following claims, and that the terms of the claims are to be given the broad meaning ascribed to them above.

I claim as my invention:

1. In a rotatable drier drum construction including a hollow axle, spaced supporting means carried by said axle, annular end plates carried by said supporting means, and a pair of spaced metallic cylinders carried by said end plates defining therewith a chamber capable of withstanding high internal pressures, means extending through the hollow axle for introducing high pressure steam into said chamber, supplemental end plates carried by the first mentioned end plates and spaced therefrom, a third cylinder of a different metal than the first mentioned cylinders carried by said supplemental end plates in coaxial spaced relation to the outer of said cylinders, a body of liquid of high heat conductivity confined within and filling the space

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between the outer cylinders and between said end plates, a closed fluid container in and carried by the innermost cylinder, a conduit connecting said fluid container with said body of liquid, and resiliently urged means in said container for varying the effective fluid capacity of said container in accordance with surges and variations in the volume of said body of liquid, said plates, cylinders and container being in fixed relation to rotate together as a unit.

2. A self-contained rotatable drier drum assembly capable of withstanding high pressures and presenting a hard homogeneous periphery adapted to withstand the action of doctors and other mechanism brought in contact therewith comprising end plates, spaced inner and outer steel cylinders carried by said plates and defining a heating chamber therebetween capable of withstanding high pressures, insulation lining the inner face of said inner cylinder for minimizing loss of heat inwardly from said heating chamber, a third cylinder composed of cast iron surrounding the outer steel cylinder in spaced relation therefrom and coacting therewith to define a second chamber surrounding the heating chamber, a fluid of high heat conductivity filling said second chamber, a closed fluid container carried within said inner steel cylinder and communicating with said second chamber, resiliently urged means in said container acting on fluid therein to vary the capacity of the container in response to variations in volume of the high heat conductivity fluid, and means for circulating a heating fluid through said heating chamber, said plates, cylinders and container being in fixed relation to rotate together as a unit.

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